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ERRATA.

Vol. XXV, No. 75, p. 318, line 23 from bottom, for "of the south," *read* "on the south."
" 8 " " for "and separates," *read* "separating."
" 2 " " for "Nevada," *read* "Sierra."

P. 67, 4th and 5th lines, for $\frac{2}{3}\dot{R} : 2\frac{1}{3}\ddot{R} : 4\ddot{S}i : 1\dot{H}$, *read* $\frac{2}{3}\dot{R}^3 : 2\frac{1}{3}\ddot{R} : 4\ddot{S}i : 3\dot{H}$, and dele the index ^{3} after $(\frac{2}{3}\dot{R}^3 + \frac{7}{3}\ddot{R})$.

P. 108, line 7 from bottom, for J. W. BILL *read* J. H. BILL.
" 158, 1st line from top, for "95" *read* "96."
" 169, in the formula and in the line below it, for "*v*" *read* "*V*."
" 170, 3d line from bottom, after "as much as," insert "one fourth of."
" 236, line 17 from top, for "80," *read* "90."
" 298, 19th line from bottom for "inside" *read* "irised."
" 331, line 5 from bottom, after "the beak of the" insert "smaller valve in the."
" 332, line 19 from top, after "identical" insert "with foreign forms."
" 333, line 10 from top, after "Cretaceous" insert "and perhaps Tertiary."

U. S. COAST SURVEY

A. D. BACHE, Superintendent

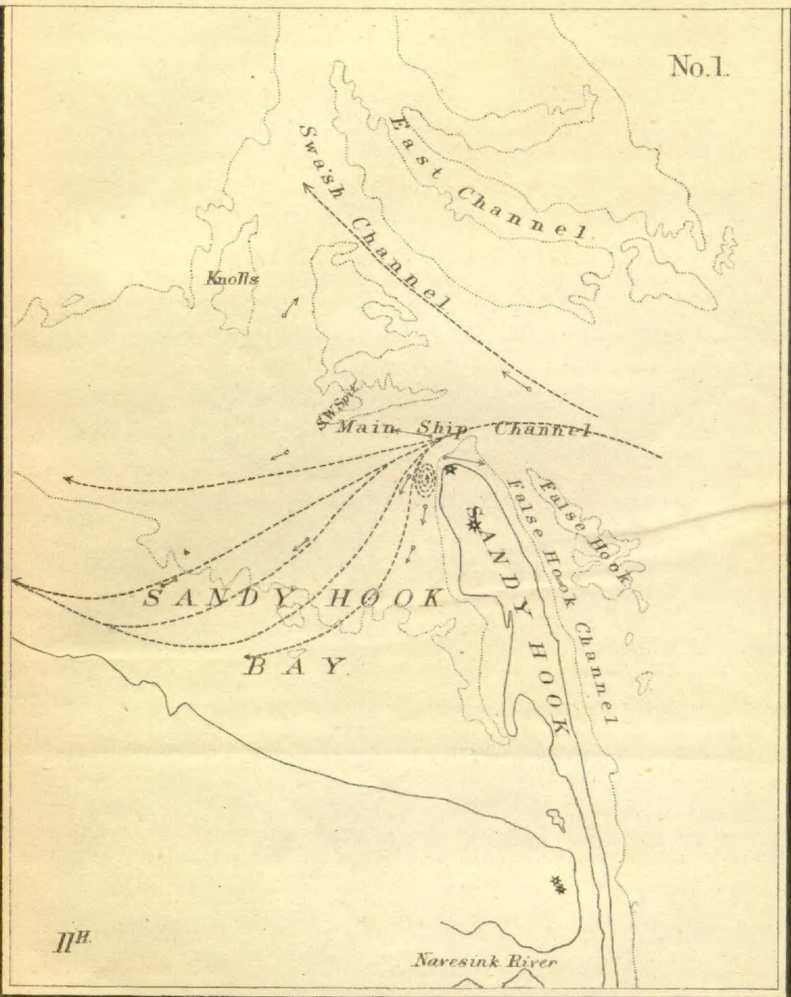
Sketches Nos. 1 to 5.

Showing the set of currents in

SANDY HOOK BAY.

18 feet curve .....

No. 1.



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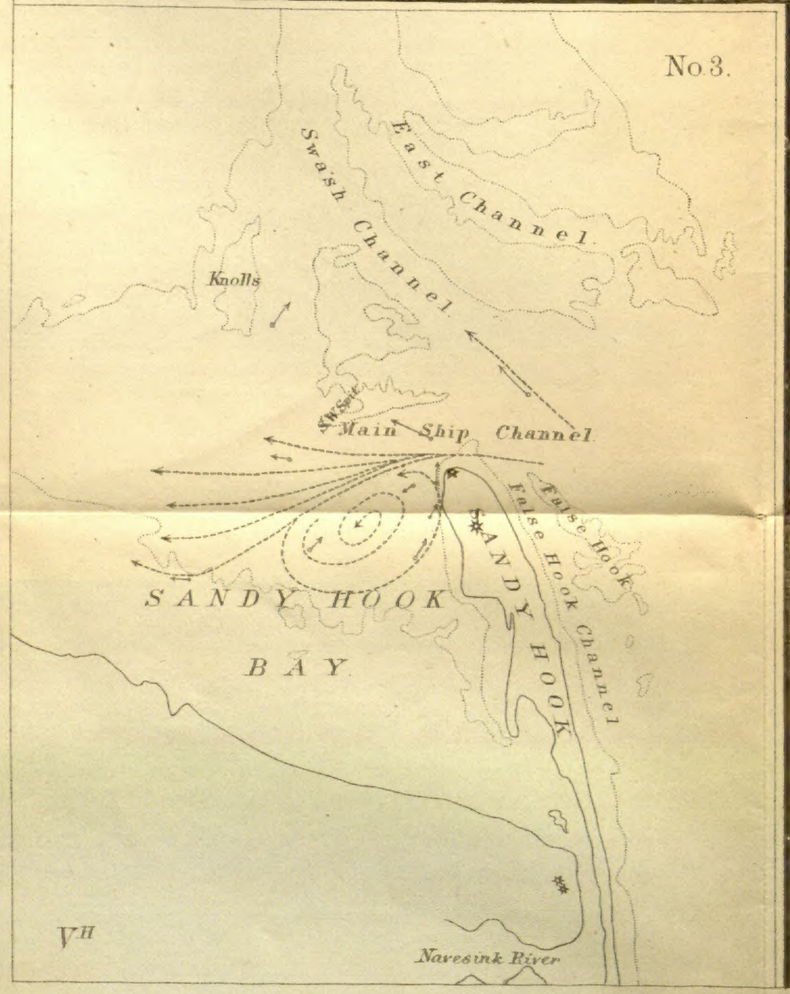

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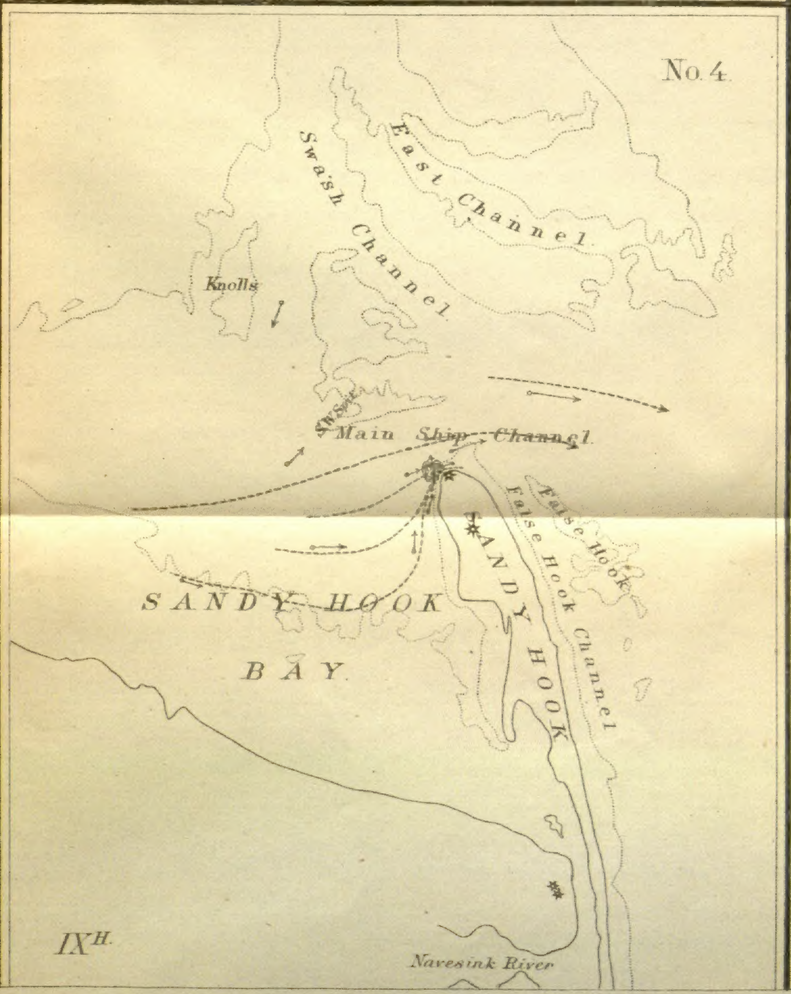


IX H.

No. 5.

XI H.

Drawn by W. T. Bright

Lith. J. Bien 60 Fulton St. N. Y.

THE

AMERICAN

JOURNAL OF SCIENCE AND ARTS.

[SECOND SERIES.]

ART. I.—*Some Experiments on Sonorous Flames, with Remarks on the Primary Source of their Vibration*; by Prof. WILLIAM B. ROGERS.*

THE production of a musical sound by a small flame of hydrogen gas burning within a tube has long been one of the most familiar of lecture-room experiments. Prof. Faraday, early in his marvellous career of discovery, showed that this musical vibration was not confined to hydrogen but could be produced with flames of carbonic oxyd, olefiant and common illuminating gas as well as several other gases and vapors; and he was the first to give a philosophical theory of the sound, by rendering it probable that in the conditions of the experiment the flame resolved itself into a series of little explosions, which succeeding each other at very small and equal intervals gave rise to regular and therefore musical vibrations in the tube. This theory afterwards confirmed by an experiment of Prof. Wheatstone, in which, with his well-known revolving mirror, he rendered visible the intermitting combustion of the singing flame, has lately received a further illustration from Prof. Tyndal's ingenious arrangement for observing the successive images of the flame as reflected upon a screen.

The recent beautiful experiments of Count Schaffgotsch and Prof. Tyndal proving that in certain conditions the flame is strongly impressible by external sounds, have given a new and

* Read before the Am. Association for the Advancement of Science, May 4, 1858.

unexpected interest to the subject, as is well shown in the curious observations of Prof. LeConte in the January number of the Am. Journ. of Science; and I need hardly add that they have also prompted the experiments and reflections embodied in the present paper. In presenting these I shall follow the order in which the experiments were made and from time to time communicated to the Boston Nat. Hist. Soc., and the American Academy during the past winter.*

1. *Production of musical sounds by flames escaping from wicks or wire-gauze.*—Early in these experiments I found that the usual absence of the sonorous effect in the case of lamps or candles burned under the same conditions as the gas, is not due, as might be supposed, to a mechanical interference of the wick with the vibrating motion. Wicks of cotton thread and of asbestus introduced into a jet-pipe of coal-gas one-tenth of an inch in diameter do not prevent the singing even when they project far into the flame, and unless spread out raggedly at the sides do not greatly impair the purity of the tone. Indeed the difficulty of obtaining continuous musical sounds from a common flame with a wick would seem to be due rather to the nature of the combustible matter, which requiring a very large supply of air to produce the explosions and evolving too little heat in combustion, is liable to be extinguished before the musical sound is developed.

By using a small alcohol lamp with a wick-tube about five inches high and one-fifth of an inch in diameter, I have succeeded in obtaining a very pure musical tone, when the blue and low flame was introduced into a resonant tube five or six feet long. The effect occurs only at a particular stage of the flame, and depends on so nice an adjustment between this and the tube as to make its repetition difficult and uncertain. With sulphuric ether the same arrangement is more frequently successful, but even this furnishes only capricious results.

To obtain an ether flame which will readily assume the sonorous state I use a lamp consisting of a glass tube about eight inches long and one-fourth inch in diameter, open below and drawn somewhat bluntly to a small aperture at top. Into this some loose cotton twine or thread of asbestus is introduced so as to terminate at or very near the pointed opening. The tube is then half filled with sulphuric ether, the larger end closed with a tight cork, and the little ether lamp fixed upright in the centre of a wooden block. On applying a light to the apex the ethereal vapor burns in a steady jet, which with proper tubes enables us readily to repeat most of the experiments on the singing flame. This simple apparatus acts freely at ordinary tem-

* My earlier experiments and the general theory of the vibration as explained towards the close of this article were presented at a meeting of the Warren Club late in December.

peratures and may be used from time to time for several days without replenishing.

Finding that the ordinary solid wick gave such unsatisfactory results even with an ether flame, it occured to me that a hollow wick by its larger exposure to the air would be more favorable to the formation of the explosive mixture, and therefore to the production of the sound. This, on trial, proved to be the fact. By using *hollow wicks*, and resonant tubes but slightly exceeding them in diameter, I was able to obtain the musical effect, with the flames of sulphuric ether, common alcohol, and the mixture of the latter with spirits of turpentine, which is known in this country as burning fluid, and by employing an iron tube at a high temperature with such a hollow wick I have obtained, though less perfectly, a musical note from the flame of sperma-ceti oil.

These results may be readily obtained with the flame of the small circular-wick lamp now in use for burning the mixture of alcohol and turpentine. In this form of lamp the wick-tube rises about two and a half inches above the reservoir, and an external movable tube is provided, which being raised or lowered serves to vary the depth of the wick on the outside and to adjust the flame with great nicety. This appendage is important also as a means of giving the exterior of the wick a smooth outline and securing an even action of the converging streams of air on the flame. The body of the lamp should be removed from its pedestal and placed on a ring-support to secure a free current of air upward through the central wick-tube.

As the effect in these experiments depends upon the access to the flame of a current of air of definite amount and velocity and in a proper direction, it is necessary to adjust the height of the flame and its position within the resonant tube to the dimensions of the latter. With a tube two feet long the flame should be short and placed so that its base may be about on a level with the lower edge of the tube. With one five or six feet in length we must use a higher flame and depress the tube an inch or more below its base. When this is done the flame will be seen to contract and lose much of its brilliancy, at the same time giving forth a musical tone which, with a little care in holding the tube, may be kept quite smooth and continuous. As a more precise guide to those who may wish to repeat this experiment it is proper to mention that the lamp above referred to has a sliding tube of about nine-tenths of an inch in diameter and an inner tube of nearly five-tenths, and that the resonant tubes best adapted to it are from twelve to fifteen-tenths of an inch in diameter, and from eighteen inches to six feet long. With these arrangements an *alcohol wick-flame affords a clear musical sound with as much certainty and ease as an Argand gas-flame.*

Those who are familiar with such experiments are aware that by the ordinary procedure a bulky flame of illuminating gas cannot be made to assume the sonorous state. Yet as might be expected when such a jet is mingled with a sufficient proportion of common air, it does not fail, with a suitable resonant tube, to yield a powerful musical tone. To bring about this result the air may be applied as a current to the surface of the flame, or it may be mixed with the gas below the place at which the combustion begins. As the effects of the former process will be shown under a subsequent head, I will confine myself to an exemplification of the latter as presented in the sonorous character of the large flame of mixed air and coal gas formed on top of a wire-gauze burner, when properly adjusted. In the ordinary arrangement of such burners the proportion of air which becomes mingled with the gas before passing through the meshes of the gauze to form the flame, is quite insufficient to bring it to the state of an explosive mixture. By perforating the sides of the chamber beneath the gauze with numerous openings and allowing also a wide entrance for the air below, we provide an efficient means for admitting a large volume of air, and for thoroughly mingling it with the gas.

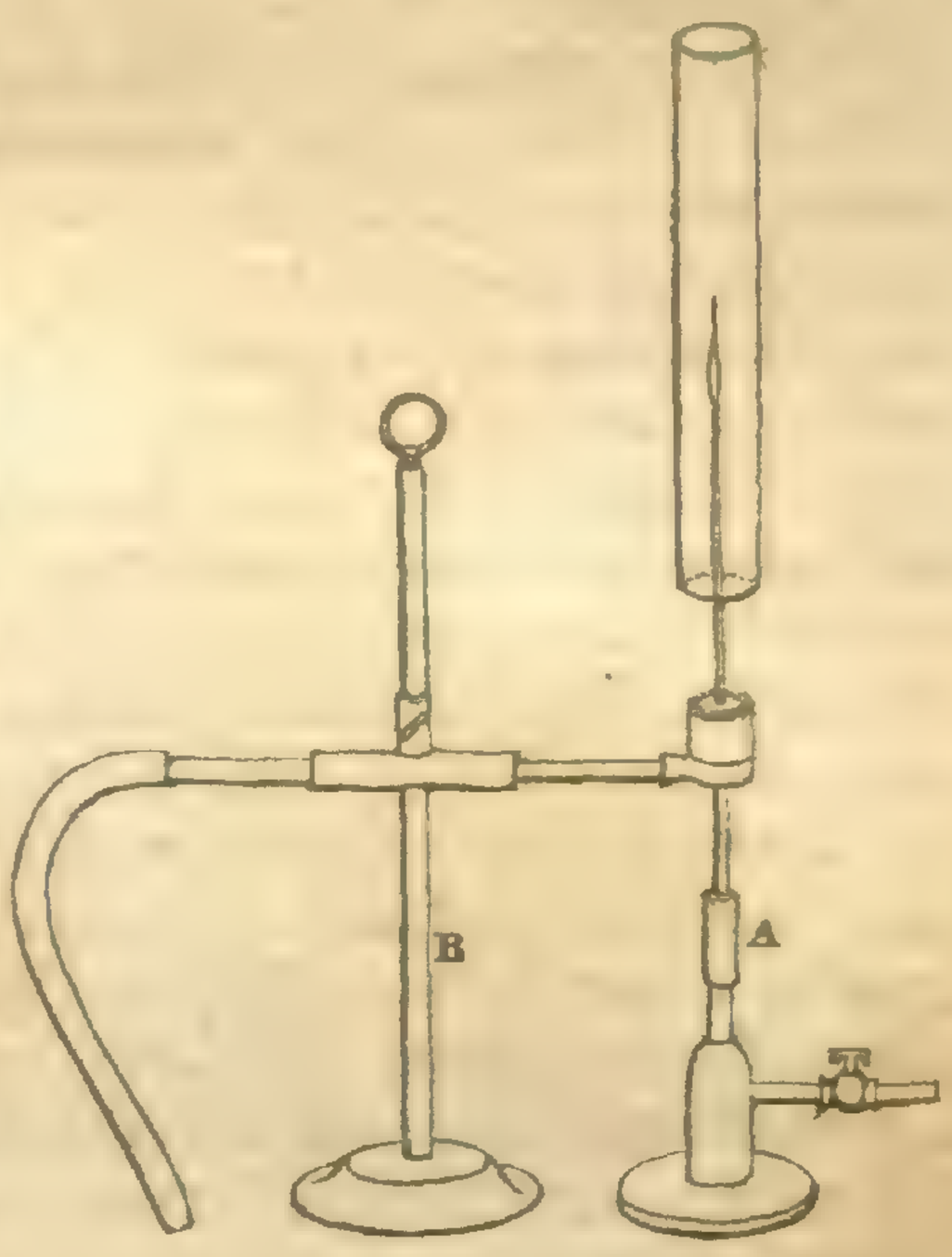
The effect of such an arrangement is strikingly seen in the powerful sonorous vibrations first noticed by Mr. W. F. Shaw of this city while experimenting with the *wire-gauze burners* which he uses in his gas stoves. On inverting one of these burners over the jet so as to bring the perforated cylinder below and the continuous metal tube above the diaphram of gauze, he found that the flame when duly adjusted gave rise to a very loud continuous musical sound which could be changed in pitch and strength by the addition of other pipes above. With a large volume of flame the tone, as I have repeatedly experienced, becomes painfully intense, as indeed it should be, considering the energy of each of the successive explosions by which it is maintained. It may perhaps be supposed that the powerful current drawn upward into the tube by the heating action of so large a flame would by its direct mechanical agency contribute largely to the production of the sound. This however is shown not to be the case by the necessity of a special adjustment of the supply of gas, and the cessation of the sound when the quantity is much increased.

2. *The sonorous state may be induced by giving a rapid motion to the flame.*—When a jet of burning coal-gas is introduced into the resonant tube in a position in which it does not sing spontaneously we may cause it to commence its musical performance by simply *vibrating the jet-pipe rapidly from side to side.* In this experiment the pipe should be covered with soft buckskin for two or three inches near its upper end to prevent the sharp jar-

ring sound caused by its striking the glass. This movement of the jet is so efficient in bringing on the sonorous state that it will compel the flame to sing even in a tube in which it would not do so spontaneously in any position in which we could place it. Indeed it will often excite the musical vibrations in cases where from the unsuitable proportions between the tube and flame the external sounds used in Schaffgotsch's and Tyndal's experiments entirely fail to bring on the sonorous state.

Fig. 1, A, represents an arrangement which I have found well suited for this experiment. The jet-pipe, about ten inches long, has an aperture above of $\frac{1}{50}$th of an inch in diameter, and is attached to the metal gas-stand beneath by a piece of rather stiff vulcanized tube, of which about one inch of the middle portion is free to vibrate. The motion is given by applying the fingers to the upper part of the elastic tube, and may easily be varied in speed and restricted in distance as we desire.

1.



Although the singing is induced more promptly when we allow the jet-pipe in its vibrations to strike the sides of the tube, this action is not at all necessary to the effect, for we obtain the same result when the pipe is merely shaken to and fro within such limits as to prevent its touching the glass. The effect here described, is so striking and beautiful that when first observed it cannot fail to excite surprise, especially if from previous trials we have found that the flame refuses either to sing spontaneously or under the action of external sounds.

So far as the impulse of the jet-pipe against the sides of the tube is influential in exciting the sound, we must ascribe its action to the feeble musical resonance produced by it within the tube, which although composed of several sounds may always be observed to include the fundamental note of the tube. This action is therefore like that of a unison note sounded by the voice or an external instrument or that of any other mechanical agency giving rise to a vibration of the included column of air. But the other and far more remarkable effect, the excitement of the musical condition in the flame by simply moving it to and fro without striking the tube, cannot be thus explained since the gentle impulses given to the air by the vibrating pipe produce

no audible effect and would seem quite inadequate to excite in the column any but the very feeblest vibration. Admitting however that these extremely faint vibrations of the air may contribute somewhat to the result, it can hardly be doubted that the main influence by which the movement of the jet produces the effect in question is by causing so rapid a mixture of the adjoining air with the gas that the latter before being inflamed is brought into a condition to produce those small explosions, which, by their quick succession, give origin to the sound. The effect of motion in bringing about this explosive condition of the flame is well exemplified by the following experiment.

Fastening a jet-pipe, some twelve inches in length, into the end of the long flexible tube through which the gas is supplied, and holding it erect by a point a little below the insertion so that we can readily cause it to vibrate, we ignite the gas and adjust it to form a slender flame about an inch long. If now the flame be moved from side to side through a distance of five or six inches, at a moderately rapid rate, it will assume, according to a well known visual law, the appearance of a continuous arch of whitish light, retaining at the extremities the whole height of the stationary flame, but growing narrower from either side towards the middle. In these conditions the flame is *entirely noiseless*. As we gradually increase the speed of the vibrations, the arch, at a certain velocity, suddenly breaks in the middle, where a faint bluish flame takes the place of the usual whitish light, and at the same instant a *sharp noise is heard* due to the inflamation of the explosive mixture at this part of the vibration. It is hardly necessary to say that as the vibration is quickest at the midway point, coming to a pause at each end of the arch, the gas becomes more largely mixed with air at the middle than towards the extremities of the motion, and is therefore at this point earliest reduced to the state of an explosive mixture.

As we increase the velocity of the vibrations, the sonorous part of the arch extends towards the ends until the path of the flame presents the aspect of a narrow bluish band irregularly serrated at top and flanked at the extremities by a tall flame of the usual whitish color. As might be expected when the jet is revolved rapidly in a circle the white light entirely disappears and the ring of bluish flame which results gives forth a continuous but not distinctly musical sound. When made in a dark room these simple experiments were found to be unexpectedly interesting and beautiful.

The sound familiarly observed when a flame of any kind is blown upon, and especially when the air is forced into and through the flame, as in the case of the jet of a blow-pipe, was long ago referred by Faraday to the combustion of an explosive mixture formed by the air and burning matter. The sound pro-

duced by a blazing fire of wood or bituminous coal contrasted with the silence of a flameless mass of ignited anthracite is an obvious illustration of the same principle. But the experiments above described show the operation of this law under conditions which enable us more satisfactorily to mark the origin of the sound and the gradations by which it accompanies the formation of the explosive mixture.

3. *The sonorous state may be induced by causing an additional supply of air to pass up the resonant tube.*—As in the above cases the action was mainly traceable to the more rapid mingling of the atmospheric air with the flame, it was natural to conclude that a like effect would be produced by passing a current of air upward through the tube, and on trial this anticipation was strikingly verified. In order that the current may be evenly distributed it is convenient to employ an argand burner having the supply pipe at the side and the central opening entirely free, so that the jet pipe may rise through the centre, and the burner be adjusted to the proper distance below the flame and the bottom of the glass tube. The air conveyed to the argand burner through a flexible pipe may be supplied either from the lungs of the operator or from an adjacent gasometer. In most cases the action of the current is more easily managed when the apertures from which it flows are some two or three inches below the bottom of the resonant glass tube. Fig. 1, B, represents the air jet in connection with the other parts as adjusted for experiment.

With this arrangement and a proper graduation of the current of air impelled into the tube we can cause the flame to sing when the other methods above described have failed to produce any effect. When the flame is not far from the position in which it would spontaneously sing, the *lightest breathing through the argand pipe is sufficient to bring it to the sounding state* and to maintain a clear smooth tone. Even when the flame is large and otherwise not readily susceptible of the sonorous action, a stronger current of air applied nearer to the bottom of the resonant tube will rarely fail to bring on the musical vibrations.

In adjusting the argand jet-pipe to the most suitable position for this effect we should be guided by the other conditions of the experiment. When the resonant tube is of moderate size, for example, three-fourths of an inch or an inch in diameter, and the flame not greatly larger than is suited to spontaneous singing, in other words, when only a small additional supply of air is required for the effect, the current will be found more manageable if made to ascend from a distance of two or three inches below the mouth of the tube. Using a much larger flame in the same tube, we must of course apply a stronger current to supply the requisite amount of air, and must therefore

bring the air-jet closer to the opening of the tube at the same time that we augment the force of the blast. With a tube of glass five feet long and two and a half inches in diameter and a gas-flame two inches high proceeding from an aperture of $\frac{1}{5}\frac{1}{0}$th of an inch, I find it best to bring the argand jet a little within the tube. Then by a gradually increasing blast I soon bring the flame to the sonorous state and obtain a deep and powerful organ-tone.

In most cases the effect above described can be produced in a simpler but less satisfactory manner by using, instead of the argand burner to conduct the current of air, a common glass tube bent suitably, and held near the jet-pipe below or just within the opening of the resonant tube.

To show that the mechanical action of the air upon the lower edge or the inner surface of the tube has no direct effect in producing the musical tone, it is only necessary to repeat the experiment after extinguishing the flame, when it will be seen that the current of air alone gives rise to no decided sound.

The effect of a due admixture of air in bringing on the sonorous state is still more strikingly exhibited when we use a concentric jet-pipe in which the current of air is blown through a central aperture in the midst of an annular stream of gas. With such an arrangement and a proper force of blast from the lungs or a gasometer, we may reduce a silent flame two or three inches in height to a short blue sonorous jet, which with a suitable enclosing tube will give rise to a sound of great volume and intensity. Using the larger tube (five feet by two and a half inches) before mentioned, I find it easy in this way to produce a tone of almost deafening loudness or one of great smoothness and purity, by increasing or lessening the supply of gas and of air.

The preceding observations agree with those of other experimenters in favoring the conclusion that *flames of every kind are capable of exciting sonorous vibrations*, provided the air and combustible gases or vapors are brought together in such proportions as to form an explosive mixture, and they therefore confirm the explanation of Faraday which refers the musical sounds produced in such cases to a rapid and uniform succession of small explosions.

4. *The intermissions of the singing flame are made visible by giving it a rapid vibrating or revolving motion.*—The intermitting character of the combustion in a singing flame has been beautifully shown by Prof. Tyndal by causing the light of the flame to fall upon a revolving mirror from which it is reflected so as to form a series of images on a distant screen. A similar resolution of the flame into successive explosions is more simply exhibited by moving it rapidly to and fro, or better still, by giving it a steady revolving motion within the tube. In using the for-

mer method the jet-pipe attached to the common gas stand by a short piece of flexible hose may be passed through a ring so placed as to restrict the vibrations to a range less than the diameter of the tube. A sufficiently regular movement may then be given by the hand. If now we adjust the flame in the tube so that it will not begin to sing for some time after the vibration has commenced or until the tube is farther lowered, we observe at first merely the continuous band of light due to the permanence of the visual impression, but as soon as the singing commences this band becomes waved or serrated at top and with a proper velocity divides into nearly separate columns of flame with obscure spaces between.

The effect is however far more striking when *the flame is made to revolve at a uniform rate in the tube.* In this case so long as it remains silent it presents the appearance of a hollow cylinder or short tube of whitish light, but the moment that the singing begins the cylinder assumes a toothed form on the top resembling a brilliant crown and *divides itself into a number of narrow luminous columns separated by bands nearly or quite deprived of light.* As might be expected, the number of these subdivisions, with a given rate of rotation, is greater in a short tube than in a long one and is greater when the tube is yielding one of its harmonic notes than when giving its fundamental sound. In the same tube the number of subdivisions diminishes as we increase the velocity of rotation, a less number of vibrations or explosions in this case corresponding to one revolution of the jet.

To render the effect visible at a distance it is of course necessary to use a large tube and flame. It is however beautifully distinct when the tube is some six feet long by one and a half inches in diameter and the flame three-fourths of an inch in height. The mechanism employed to give rotation to the jet consists of a grooved wheel connected by a band with a small pulley (fig. 2). Into the latter the supply-pipe enters from below by a smooth gas-tight joint which allows the pulley freely to revolve. The jet-pipe secured to the middle of the upper face of the pulley tapers to the extremity, and rising to the height of six or eight inches is elbowed near the top so as to give the flame when revolving an orbit of about an inch in diameter. To secure the pipe more firmly in its upright position it is made to pass near its base through a narrow gallows of brass in which

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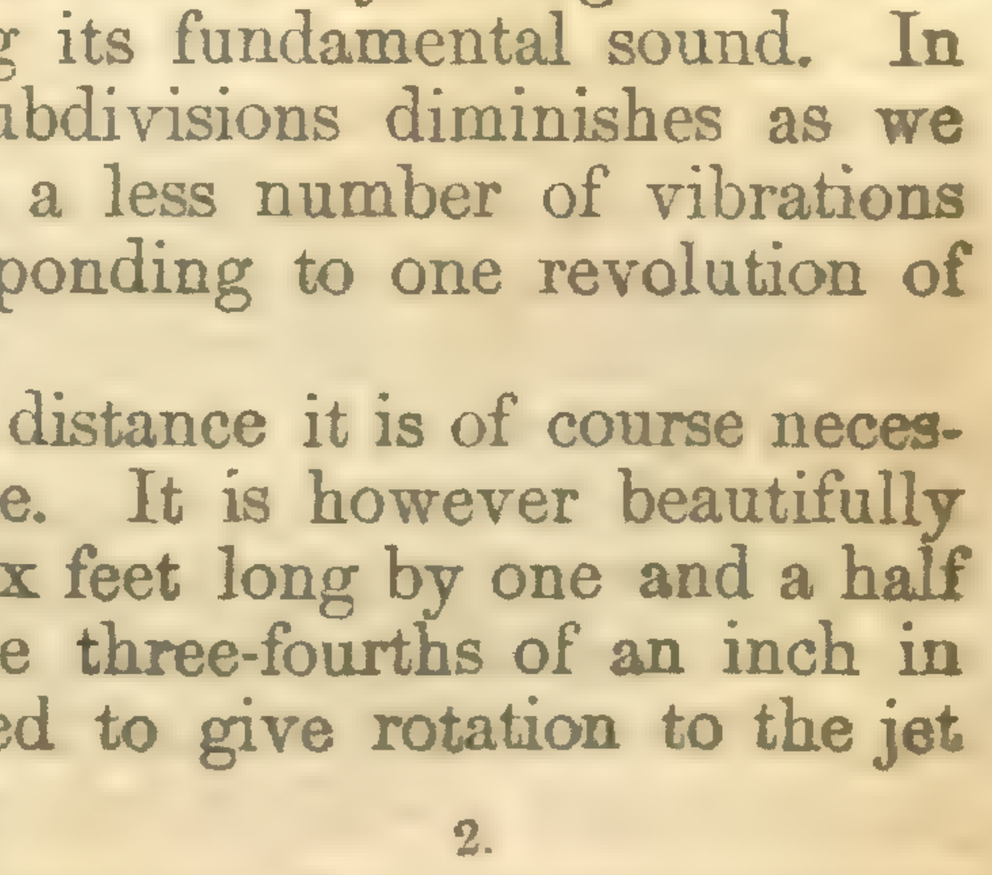

it turns freely. This, which is represented in the figure by the dotted lines, has two little cushions of buckskin glued on the top, for the convenience of supporting the larger tubes during the experiment.

In making this experiment it will be remarked that although in the first instance the rotation of the flame often serves to excite the vibration, an increase of velocity weakens the force of the sound, and a very high speed actually annuls it, the flame at the same time resuming its normal appearance of continuity. This effect is not due, as might be supposed, to the air carried round by the revolving motion obstructing the full supply of oxygen to the flame, for I have found that it is not perceptibly increased by attaching a disc of card to the revolving arm of the jet-pipe, and moreover I have observed that a small singing flame after being silenced by very rapid rotation shows throughout its circuit the blue column due to a full admixture of air. More probably the cause of this weakening and destruction of the sound should be sought for in the mechanical interference of the successive pulses due to explosions at widely separated points in the orbit of the flame; but further observations are needed clearly to explain the effect.

As in the explosive state the flame has extremely little illuminating power, we must conclude that in the above as well as the following experiments, the obscure intervals mark the periods of explosion, and the bright ones the periods in which the gas burns in the ordinary way with a luminous white flame.

5. *The intermissions of the singing flame are made apparent by a moving object which it illuminates.*—While the experiment above described is in progress the appearance of the horizontal arm of the jet-pipe affords incidentally a pretty proof of the intermittence of the singing flame. As the recurrence of the bright flame between the successive explosions makes this part of the pipe strongly visible, it assumes the aspect of a number of spokes corresponding to the subdivisions of the crown of flame; and if to vary the effect we blacken the horizontal arm and fasten near its outer end, or where it assumes the vertical direction, a brilliant bead of glass or metal, we are presented with a circle of starry points each of which by a proper adjustment of the motion appears to be at rest.

The following proof of the intermitting nature of the singing flame, suggested by the effects just described, is at once so simple and so readily seen at a distance, as perhaps to merit a place among useful lecture-room illustrations. In this experiment the jet-pipe bearing the flame is held at rest in the tube and the required effect is produced by receiving the light on a circular disc of thick pasteboard or of metal some six inches in diameter, supported near the tube on a horizontal axis around which it

may be revolved by the impulse of the hand. The face of the disc next the tube, colored of a dead black with paint or a covering of cloth, should have a narrow strip of white paper fastened upon it in a radial direction, or a small circular bit of the same placed near the edge. If both faces are used alternately we may affix the white bar to one and the dot to the other. On bringing the six-feet tube down over the flame and giving rapid motion to the disc, we remark that so long as the flame continues silent the bar or dot is quite invisible, but as soon as the sound commences the black disk becomes diversified by a series of whitish images of one or other of these objects arranged at equal intervals around the central point. It is scarcely necessary to say that the number of these images as well as their apparent motion and rest will depend on the time of rotation as compared with the interval of the explosions of the flame. Should it happen that the period of one revolution of the wheel is precisely that of a certain number of the explosions neither more nor less or that of any multiple or sub-multiple of this number, the images of the bar or dot will continue in each successive rotation to present themselves at the same points, but should such a relation not subsist these images will be seen to shift their places on the disc sometimes appearing to advance and at others to retreat.

6. *On the primary source of the vibration of singing flames.*—The preceding experiments taken in connection with those of Faraday, Wheatstone, Tyndal and others, afford conclusive proof that *the immediate cause* of these vibrations is to be found in the periodically explosive combustion of the gas. But the important inquiry still remains, *whence arises this periodicity*, why, instead of being uniformly continuous, is the combustion of the singing flame regularly intermitting in its character?

In seeking to account for this peculiarity of the combustion we are at once led to inquire whether it may not originate in a vibratory motion proper to the jet of gas, independent of its burning. Even were we unprovided with direct proof of such vibratory motion in jets of air, we might, with some probability, infer its existence from the similarity of effects produced on flames and on water jets by external sounds; and this is the course of argument used in the interesting paper of Prof. LeConte published in a late number of the Am. Journal of Science. But happily we are not left to the guidance of analogies or plausible conjectures in deciding this matter. Some experiments of Savart* and more recently the elaborate researches of Masson† and Sondhauss‡ have furnished abundant

* It appears that these results announced by Savart in his Lectures on Acoustics in the College de France were published by Masson in the Journal d'Institut.

† Annales de Chimie et de Physique, 3e Ser., xl, xli.

‡ Annalen der Physik und Chemie. Band xci.

positive evidence of the vibratory movement of jets of air flowing through small apertures. As these important results appear to have escaped the attention of Prof. LeConte and other late writers on sonorous flames, a particular reference to them may be useful in this place.

Felix Savart, as is well known, demonstrated the existence of vibrations in liquid jets, traced them to their source near or at the aperture, and showed that they were not only susceptible of being variously modified by tones of proper pitch sounded near them, but were capable under certain conditions of emitting of themselves distinct musical sounds. He did not however stop here, but in the words of M. Masson, "including all fluids in a general theory attempted to reproduce with gases the beautiful phenomena which he had demonstrated in regard to liquid jets." According to the same authority, "he showed by several experiments that water and elastic fluids present the same phenomena in their efflux." By a method described at length in Daguin's excellent Traite de Physique (vol. 1, p. 524) he proved that *a jet of air escaping from a vessel through a small aperture exhibits a succession of enlargements and contractions in its course similar to those seen in a jet of water.*

These conclusions have since been confirmed and extended by Masson, who, from an elaborate series of experiments, has demonstrated,

First—That the flow of air or gas through an aperture in a metal plate is not continuous but periodically variable, and that the aperture is the seat of a vibratory movement which produces a sound by acting on the exterior air.

And *Second*—That the number of vibrations performed by the air at the aperture is directly as the square root of the pressure, and is independent of the diameter of the orifice.

Referring to experiments with sonorous tubes placed in connection with such apertures, Masson has shown

First—That the sound of a sonorous tube is primarily produced *at the aperture* by the periodically variable flow of air and

Second—The sound of the aperture is re-enforced by the sonorous tube when the tone of the latter is exactly or nearly an harmonic of that of the orifice, so that the same mode of vibration may be excited in the tube by very different sounds of the orifice.

Among other results bearing upon the present enquiry, this able experimentalist states the important fact, that the vibrations proper to the orifice and those of the column of air in the sonorous pipe re-act upon each other so as to produce a unison of the different parts of the system, although these separately taken would originate different sounds. It will readily appear that this extension of Savart's well known principle of

the vibration of systems is directly applicable to the phenomena of sonorous flames.

By an independent series of experiments, Sondhauss has been led to similar conclusions as to the mechanical condition of the air-jet and has furthermore attempted to account for its vibration, as had been previously done by Cagniard-Latour, by the friction of the issuing column against the sides of the aperture. Among various important observations recorded in his elaborated memoir the following will strike the reader as interesting from its analogy with some of the phenomena of singing flames.

He states that *on sounding an organ pipe near the aperture we observe certain sounds of the pipe to be accompanied by a secondary sound produced by the air-jet which is either in unison with that of the pipe or an octave below it.* Have we not here an exact counterpart of the beautiful experiment of Tyndal and Schaffgotsch, in which the silent plane is made to sing by sounds of a certain pitch produced in its vicinity? Alluding to this observation of Sondhauss, Masson suggestively remarks, "that the fact seems to him to admit of no other explanation than that which Savart has given of the influence of external sounds on liquid jets."

It should be added that both Masson and Sondhauss have proved that neither the material of the aperture nor its shape have any influence on the cause which produces the sonorous vibration of the air-jet.

The above brief reference to the discoveries of Savart and those who have followed in the same line of investigation is sufficient to show that jets of air under the conditions of these experiments, and doubtless all air-jets, in a degree, are, at the moment of efflux, impressed with a vibratory or periodical movement, and that *this is the primary source of the vibration in singing flames.*

In view of these facts we may describe the principal phases in the production of the singing flame, briefly as follows.

First. Every jet of gas and therefore of flame is at all times the seat of a vibratory motion, but under ordinary circumstances this is too feeble to produce either audible or visible effects.

Second. When the jet is placed in conditions to favor an explosive combustion the remissions and intensions of the jet due to the vibratory motion, render the explosions more or less discontinuous, and thus add greatly to the energy of the vibrations.

Third. These vibrations of the explosive flame occurring within a resonant tube of suitable proportions, become accumulated and re-enforced, until by the mutual reaction of the vibrating jet and the air column a unison is produced corresponding more or less nearly to the fundamental note, or one of the harmonics of the tube.

It thus appears that the vibratory movements of singing flame are directly traceable to mechanical conditions which have been *actually proved* to exist in air-jets at the moment of their efflux. We are therefore not called upon to resort to conjectural properties of gaseous streams in order to explain them.

As to the mode in which these primary vibrations are excited at the aperture, whether by friction or some other special cause, we are not perhaps prepared in the existing state of our knowledge to form a satisfactory theory. But whatever may be their cause, few I think will be disposed to explain them by any assumed *cohesive action* of the particles of the gaseous stream. The analogy between jets of air and those of liquids so far as these vibrations are concerned, has been shown by Masson and Sondhauss to be only partial, but even were it more complete we could have no difficulty in admitting that the impelling forces, in the one case the elasticity of a pent-up mass of air, in the other the weight of a liquid column, must produce effects in many respects *alike* upon the issuing streams of gas and liquid.

In attempting to apply the theory of liquid jets so beautifully developed by Plateau to jets of gas, we are obliged with Prof. LeConte to ascribe to the gaseous molecules a mutual cohesion sufficient to mould the issuing stream into alternating enlargements and contractions, or in other words we must suppose them to be actuated by a cohesive force exceeding their repulsion. It is hardly necessary to say that this assumption is opposed to the unquestionable fact that it is a molecular repulsion which drives the particles through the aperture, and that the same force *acting in the jet* causes it when received into a vacuum rapidly to diffuse itself in all directions. The gaseous state is but another name for ponderable matter composed of self repellant particles; nor so long as this state continues can we conceive the particles to be controlled by the opposite or cohesive power. Taking the view adopted by some that both these forces are at all times present in gases, we must still allow a great preponderance of repulsion, to account for the mechanical properties of the mass. When by strong compression the gas is brought near its point of liquefaction, we may conceive this relative preponderance of repulsion to grow rapidly less and thus to cause the departure from the law of Marriotte which has been observed. But evidently until the molecules are in the act of uniting in the liquid form, repulsion must be their predominating force. The deviation from Marriottes' law marks only a decreasing rate of repulsion, not an efficient energy of cohesion among the particles, *the latter not coming into play until the particles are actually coalescing to form the liquid mass.*

As regards the analogies of shape between sheets of flame and of liquids developed by concurring jets, which have been sug-

gested as indications of gaseous cohesion, it may be remarked that in both cases the form is doubtless due in great part to the composition of the oblique forces of the concurring jets, and that the resemblance is perhaps further increased by the resistance of the air, producing on the air-jet an effect in some degree the same as that of the mutual cohesion of the parts in the jet of liquid. Indeed if from such analogies of form we are to infer the control of cohesive force in streams of air, may we not with equal reason, in comparing the eddies and whirlpools of water with the dust-bearing spirals and huge gyrations of the air, ascribe to the latter a cohesive action like that which we know to operate in the corresponding liquid forms?

While thus expressing my dissent from such an application of Plateau's theory of liquid jets, and from any other view which would ascribe an effective cohesion to matter in the gaseous state, I gladly bear testimony to the clearness with which Prof. LeConte has presented his suggestions in its favor, as well as to the interest of other points in his paper.

ART. II.—*Enquiries concerning Stellar Occultations by the Moon and the Planets,—experiments upon Light and Magnitude in relation to Vision;* by Prof. A. C. TWINING.

IF, by the employment of any advanced means or modes of observation, or by any additional pains-taking, the occultations of fixed stars by the moon or the planets can be made more clearly and more frequently than at present a visibly determinate phenomenon, an important acquisition will be gained to astronomy. The illuminated discs of these occulting bodies, having an enormous area relatively to the minute stellar discs, overpower the latter at and near the place of contact, notwithstanding the difference of intensity in the two illuminations. Many orders of the telescopic stars are thereby excluded from this class of observations. How far the means which it is my present purpose to propose can be made available has not yet been determined instrumentally,—but they follow as a direct inference from the relative law of light and vision experimentally developed by myself, as will be shown before I have done. The means are so simple and obvious that, for years, and ever since they occurred to me, it has appeared surprising that something of the kind had not been employed at once, as soon as the equatorial movement came to be applied to telescopes. But the object of this paper includes, also, certain applications of the class of observations above mentioned, which do not appear hitherto to have been explicitly noticed. To these, in the outset, a brief attention will be given.

Occultations by planets available for determining the sun's horizontal parallax.

As, in the transits of Venus, a slow apparent motion of the planet, measurable by durations of the transit, is made, differentially, to express a minute change of parallax, so in occultations by the planets the periods of the star's disappearance may be employed in a parallel manner for the same purpose. But the latter phenomena—supposing them equally observable with the former—possess several remarkable advantages:—

First, In their greater frequency (if effectually brought within observation).

Second, In the probability that the phenomena may occur, at times, in a position of the planet near one of its stationary points, —so giving, by the slow apparent motion, an exquisitely *micrometric* measure of parallax.

Third, In a great change of duration becoming the measure of only a small lateral parallactic change in the line of the star's transit behind the planet.

On the other hand, it is true, we may have to meet the disadvantage of an increased distance from the object whose parallax is required,—also of a presumptive irregularity in the planet's outline,—and also of the possible existence of planetary atmospheres having no definite boundary.

In the following diagram let A B represent a portion of the planet's central path or orbit; *a b* the apparent relative line of motion of the star *s* viewed from a terrestrial station, and *a′ b′* the similar path of the same star *s′* as seen from a station far north of the former (the planet's motion being from A to B).

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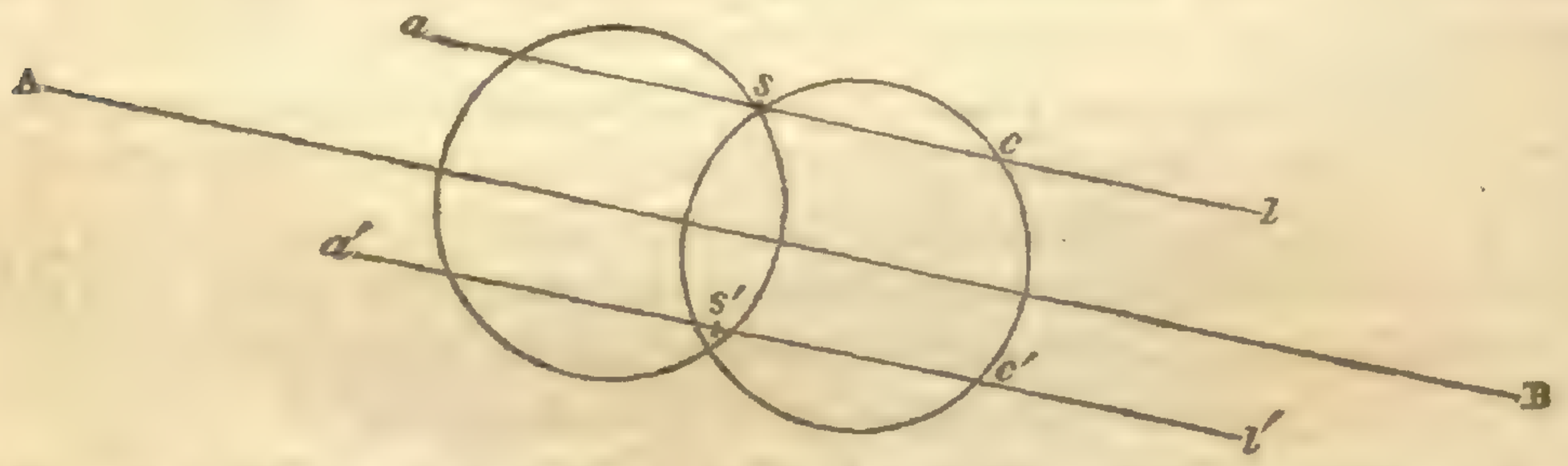


The two circles represent the planet's visible outline. The planet's mean angular diameter is supposed to be known by an average result of transits observed near and at measured approximate distances from its central path; and the ratio of its polar to its equatorial diameter is supposed to be given by the observed period of the planet's rotation;—we then compute the chords *s c* and *s′ c′* from the observed periods of disappearance of *s*, and the sum (or difference) of the distances of those chords from the planet's visible centre becomes the measure of the parallax—a measure the more accurate—according as the chord has a position the more nearly at its extreme from the centre.

Now, as an illustration and confirmation of remark "third" in the preceding paragraph, it will be observed that if Mars is the occulting planet it presents an instance in which parallax of a terrestrial base may be almost double the planet's angular diameter. Of course it will very commonly occur (and might in the majority of instances be made to occur by a suitable selection of stations) that the chords sc, $s'c'$ shall be thrown so far from the centre as to become small compared with the diameter, and shall therefore offer an unprecedented accuracy in the resulting parallax. If Venus were the planet the stellar transit as seen from one station might similarly occur (or be made to occur) nearly at an extreme position, but then, as seen from the other station it would generally be much more nearly central. If Jupiter were the planet it could only offer a striking advantage in case of fortuitous presentation of both chords in one and the same semicircle of the disc, and at or near an extreme distance of both from the centre.

Again, as an illustration and enforcement of the above "second" remark, it need only be observed that even so distant a planet as Jupiter, by its slow apparent motion when nearing or leaving its stationary points in the heavens, might show a great difference of times as the measure of a minute parallax. And this is equally true whether the terrestrial stations are so situated with respect to one another as to give a parallax, like that assumed in the diagram, normal to the planet's line of orbital motion, or situated relatively east and west in a manner to throw the parallax along that orbital line. Of the nearer planets, under a like favorable concurrence of circumstances, the same may be predicated (although, like the former, an extremely rare event) and with the farther advantage of a greater range of path through which the possible occurrence may be realized.

With respect to the above "first" remark, or that which relates to the frequency of occultations by the planets, I have found, since this article was commenced, a computed result by Dr. Winnecke, in the Astronomische Nachrichten, vol. 46, according to which it would appear that Saturn, with his rings, may be expected to occult some one star of not less than the ninth magnitude in each two years, on an average. Allowing this result we find by a rough computation that Jupiter ought similarly to occult a star once in each year, Mars over four times in each year, and Venus with a much greater frequency than either. But these numbers will be greatly reduced if restricted to occultations which shall admit of observation in the hemisphere from which the sun is absent. For the present object it is sufficient that these phenomena may be expected at such moderate intervals as to justify the labor of exploring the planetary paths in advance and bestowing extraordinary attention upon those stars

which may be occulted—they being generally individuals of the lower magnitudes that would otherwise remain undistinguished among the multitudes of their class. Moreover, such a planetary occultation, although but one of a century, *might* be more worthy of attention than any ordinary transit of Venus.

Mars, on account of its periodical presentation in the dark hemisphere for six months together,—its slow motions back and forward during that period,—and its favorable magnitude of disc, may not improbably obtain the preference, even over Venus in this mode of employment,—notwithstanding the far greater number of occultations, in a given time, by the latter. These remarks lead to the main topic of our enquiry, viz:—

The means of observing a small star in contact with an illuminated disc.

The object in this kind of observation not being distinctness of visible form or color but the mere disappearance and reappearance of stellar light, it is immaterial whether that light presents itself as a brilliant point or as a mere round nebula or haze. The spurious discs of several orders even of the fainter stars are believed to possess in the telescopic field a great intensity, compared with any focal image of a mere reflection—a planetary surface, for example. It is also a law of vision or of *perceptibility*—as will more definitely appear in the close of this paper—that a given quantity of light augments in perceptibility by expansion over an increased area or surface up to a certain degree of diffuseness, beyond which the perceptibility or effect upon the organs of vision rapidly diminishes. It is possible therefore by increase of magnifying power to pass the maximum of visibility for a fainter illumination long before that maximum is reached for a stronger. Not only so, but after the last named maximum is passed, the brighter illumination (according to the law hereafter deduced) fades, in its effect, much less rapidly than the weaker. In general therefore it may be presumed that any star whatever which is competent to exhibit a spurious—or rather a *focal* disc in the telescope (a disc expanded by irregularities of refraction) that exceeds very greatly in illumination the planetary disc in the same field is also competent to exhibit visibly the phenomena of disappearance and reappearance of the star behind the planet, even in contrast with the bright limb of the latter. In this proposition it is assumed however that the visible area of the planet shall be narrowed to the utmost practicable limit in the telescopic field,—in other words, that the telescopic field shall be covered at the focus by an opaque diaphragm perforated with a single opening made as narrow as allowable and centred upon the telescope's line of collimation. In this proposed darkening of reflecting surfaces there is nothing (the dia-

phragm perhaps excepted) but what has occurred in practice, but the question remains whether practice has distinctly recognized and carried to its limit the advantage obtainable in this way. My purpose herein is to fix attention strongly on the simple enquiry *whether immersions and emersions hitherto invisible may not be brought out to observation by narrowing an equatorially moving field to the utmost limit of the telescope's stability, and pushing magnifying power to an extreme.*

Effects of Planetary Atmospheres.

If the planet has an atmosphere it will obstruct our purpose vitally, unless that atmosphere has a definite boundary. Under the latter supposition, a star's disappearance, it may easily be proved, must be, for the moment, as complete and sudden as if the opaque body of the planet without an atmosphere extended out to that boundary. Indeed such a physical feature would afford the advantage of an even occulting line, in place of the more or less irregular outline of the planet's disc. It is true the star will reappear,—and its reappearance may very quickly follow the disappearance. But, however brief, if the interval can be perceived for an instant it is sufficient; and, on the other hand, even an excessively feeble refraction will give that sufficient instant. If however the atmosphere declines into space insensibly the star will move progressively outward from the planet, and fade away by a long gradation in which the eye can fasten upon no abrupt degree for the signal of observation. Thus, to an inhabitant of another planet who should observe an occultation by the earth, and with an eye capable of perceiving rays however faint, this progressive fading would continue for an entire day—or it might be, in some circumstances of the earth's apparent motion, for several days.*

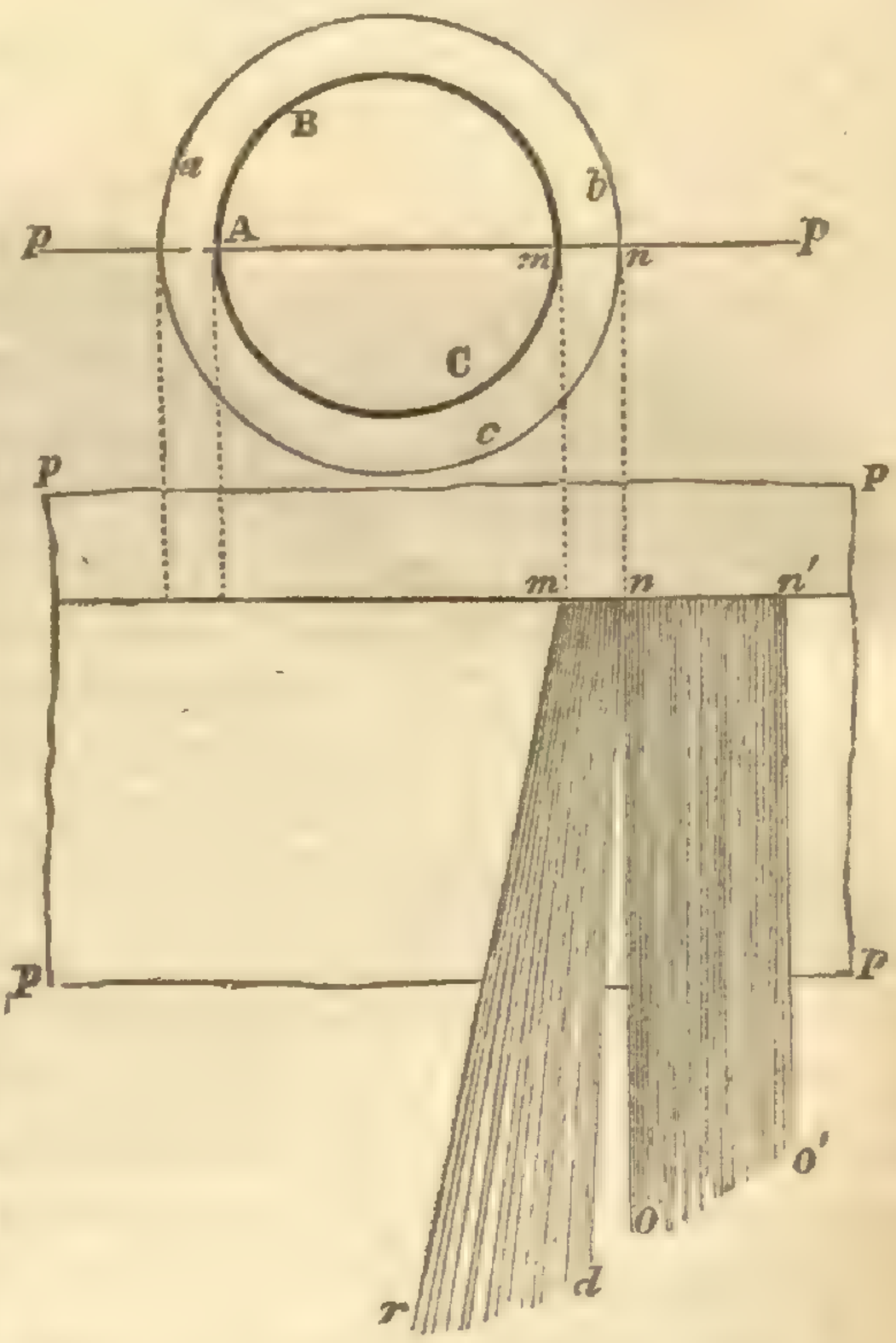
But if the constitution of nature is such that material bodies are composed of atoms it must be true, apparently, that at a certain distance from a planet the stratum of atmosphere becomes of so feeble tension that the gravity of the atom must balance the repellency of the same. All the evidence therefore which applies to that supposed constitution of material masses supports the conclusion that the planetary atmospheres, where they exist, are, in fact, circumscribed definitely. The same conclusion is also supported by the common received evidence which, to some

* To some readers the following demonstration of these effects may appear requisite:—Let A B C be the outline of a planet's disc seen at the earth and having a star at *n*, just at the boundary of the planet's atmosphere, *a b c*. The planet's disc being normal to a ray from *n* to the observer's eye, pass a plane, *p p*, through the rays cutting the disc centrally in the line A *m n*, revolve this plane down and give it the position seen in *p p p p*. The rays in the broad beam, *n n′ o o′*, are all parallel, and *n o* is the ray to the observer's eye just antecedent to the instant of contact with the atmospheric boundary, *a b c*. But the very next ray, *n d*, is re-

extent, favors the idea of an existing atmospheric limit in the instance of our own planet.*

Thus our present enquiry opens a remote possibility of bringing astronomical observation to bear conclusively upon the most fundamental question respecting the constitution of material masses. It opens also a possibility much less remote of determining partially another point, and that of great interest in stellar astronomy,—I mean the actual angular magnitude of certain

2.



fracted so as to leave a space, $d\,n\,o$, destitute of the star's light; and however small the angle of refraction it is sufficient at the great distance of the earth to create a dark interval and a consequent disappearance of the star. But let the planet move forward relatively to the earth the breadth of that interval and then let the ray, $n'\,o'$, touch the atmospheric boundary. Immediately the ray, $n'\,o'$, will be refracted in parallelism to $n\,d$ and so will reach the observer's eye. The star will therefore reappear; but it will be seen forward of its true position by the angular distance, $d\,n\,o$. Moreover as the planet moves onward, rays directed between $n\,d$ and $m\,r$ will come to view in succession—each fainter than what preceded, in consequence of being more dispersed by passing through the more and more dense atmosphere. In the supposed case of an occultation by the earth the last ray, $m\,r$, would be deflected more than an entire degree. It would reach an eye therefore at the surface of another planet only when the earth had advanced that amount in its apparent motion.

But if the atmosphere should extend indefinitely, there would be no angular break, $d\,n\,o$, and of course no disappearance. In this case even $n'\,o'$, and every other ray from $m\,r$ outward would be deflected, although less and less, until the deflection became imperceptible. And with the first perceptible advance of the star and progressively increasing dispersion of light its fading would commence, but would not be complete until the eye had received $m\,r$.

* In the only good opportunity ever improved by myself for watching the definite disappearance of the twilight, its boundary settled below the surface of Lake Erie with almost as much abruptness as the sun's limb, and at very nearly one hundred minutes after. I had changed place between the observations, but without change in the uncommon clearness and quiet of my horizon. The instant of disappearance was uncertain by no more than fifteen seconds; and even this could be explained by the gradual settling of the solar limb which was shining upon it.

It is the atmosphere *proper* that is here referred to. Upon the philosophy of atomic limits, there must be, it would appear, a secondary atmosphere of watery vapor having its own separate limit,—also an independent atmosphere of each constituent gas,—unless the latter subsist in chemical union with one another. In fact, since it is believed with good reason that the luminous condition of shooting stars is attributable to the intense condensation of gaseous matter collected in front by their rapid motion, it may be inferred that a medium of gaseous material exists at the greatest observed elevation of those meteors.

of the fixed stars,—and, consequently (in union with future parallactic determinations) their real magnitude. It is questionable whether Sir John Herschel's account of the insuperable difficulty of this determination will not be found to require a qualification.* The case, it is true, seems desperate so far as micrometric measurements are concerned: but the apparent motions of certain of the planets—indeed of all the planets in certain parts of their revolution—are so sluggish that $_{1\,0\,0}^{1}{}''$ or even $_{1\,0\,0\,0}^{1}{}''$ of arc would require an appreciable time for its description, and consequently for the total obscuration of a star of the like diameter. Moreover, suppose that upon rare occasions in the course of ages certain stars should present themselves upon any planetary outlines, within a few degrees of those points of the same whose tangents were parallel to the apparent orbital motion at the time:—then, for those particular stars, the angular diameter might become known by the observed duration of their fading.† But for this we need not go forward into the ages. Mars itself, once in every few years, will probably afford such an opportunity to any observer who is able to occupy a judiciously selected locality for the observation. Irregularities of outline (in the absence of an atmospheric limit) may, it is true, embarrass some of the results,—but not all of them, it is probable,—especially if observers at different neighboring localities improve the opportunity together. In a similar aspect of the case even the moon may become a useful auxiliary, through a like selection of localities, if by an antecedent preparatory study of the lunar outline (during eclipses especially) there can be found in the immediate vicinity of her poles any considerable extent of arc with an even contour, or even a small length, free from fissures, elevations, or other perceptible irregularities.‡

As already proposed I conclude, with some experimental results, obtained in April, 1847, which bear upon the foregoing discussion, and which had for their object:—

* "From the distance of the stars we are naturally led to the consideration of their real magnitudes. But here a difficulty arises, which, so far as we can judge of what optical instruments are capable of effecting, must always remain insuperable." —Outlines of Astronomy, Art. 816.

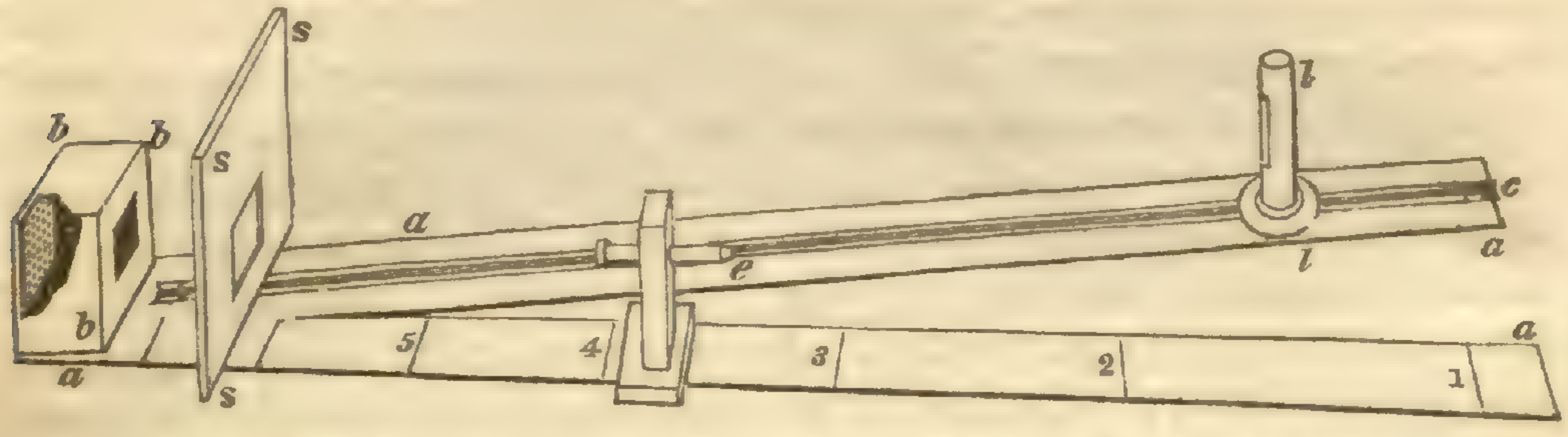
† To ascertain this duration, even approximately, might require the employment of an artificial focal disc both variable and measurable in brightness. Numerous comparisons with the star about to be occulted having denoted, upon the measuring index, a point of reference for equivalence with the star, the auxiliary disc, being set to a reduced but known degree of brightness, would give, by comparison with the fading star, one *epoch* of the observation, of which the other would be, the star's disappearance. The two together will afford data for computing the whole period of progressive disappearance.

‡ In this the entire absence of a lunar atmosphere is admitted. But the eclipse of Sept. 18th, 1838—which *just missed* being annular at New York—manifested, according to my observation, during more than two minutes of time, the distinct phenomenon of a thread of dense, *murky* light, completely around the non-eclipsing arc of the moon's limb.

The relations of illumination to magnifying power, when visibility is maintained.

A feebly illuminated area obliterates a point close to it, although of a much stronger light. We desire to know the laws which govern such an effect. Again, with the telescope, visibility depends both upon light and magnifying power. By increasing power we disperse light; and a true theory would determine from the data, under given circumstances, the arrangement proper for a maximum of penetrative power or visibility. My arrangements for the experiments above alluded to are figured below. They might be improved in almost every particular,—yet the indicated results, although with some evident latitude, appear to be unmistakeable.

3.



I prepared a frame, *aaaa*, with two branches. At the narrow extremity I placed a box, *bbb*, blackened within and without and having within on its back a paper regularly marked with small black round spots equidistant and regularly arranged (as seen through the broken side and top in the drawing). Light was thrown upon this paper through a square opening in the front of the box and a corresponding opening in the blackened screen, *sss*, so placed as to cut off the scattered rays in the room both from the paper and the eye of the observer. The source of light was the enveloped lamp, *ll*, which was moveable along a groove in that branch of the frame by a cord, *cc*, assisted by small friction sheaves. The other branch of *aaa* was graduated into distances increasing from the paper, in a geometrical progression, having the ratio $\frac{5}{4}$. On this branch there rested a fixed block carrying an eye-tube, *e*, of 0·16 in. circular aperture, and three inches long. This was directed to the paper seen through the openings in the box and the screen. The mode of proceeding was to fix the orifice *e* successively at the divisions of the progression, and, looking steadily through *e*, to move the lamp, *ll*, by the cord, *cc*, till the cluster of black spots became just resolved—or was just ceasing to be visible as a distinct cluster. The principal defect of this apparatus was a want of equable motion in the lamp, arising from the yielding of the cord and friction in the groove. The light would often move fitfully, not obeying the hand; and the eye would become fatigued before

the rectifications were well complete. Under the most favorable circumstances this species of observation is liable to large discrepancies,—however, a mean of many observations may give a reliable average. The observations made at each graduated distance were limited to four pairs. In the following table the first, or left hand, column contains the number of the observation or eye-station,—the second column gives in inches the distances of the eye at those stations from the paper,—the four columns following record the corresponding lamp distances, as observed. The seventh column contains averages of the four sets of observations,—and the last is a column of empirical distances computed for comparison, after the law of a common difference indicated by those averages. At the nearest station (and greatest corresponding lamp-distance) the faint illumination and consequent straining of the eye created occasional brief paroxysms of distinct and magnified vision which introduced uncertainty. These, in the then faint perceptive condition of the sight, may have been direct impressions of the imagination upon the retina,—or the mind may even have mistaken its own distinct conception of the visual object for a visual effect.

Tabular observations, April, 1847.

No. Stations.	Eye-distances	Lamp distances.				Averages	Computed do.
1	134·11	14·5	14·8	18·2	14·5	15·5	14·8
2	107·29	34·3	29·5	27·6	26·4	29·5	30·8
3	85·83	40·5	51·7	50·6	46·5	47·3	46·8
4	68·66	57·4	69·2	61·9	64·7	63·3	62·8
5	54·93	74·9	77·1	74·7	79·1	76·5	78·8
6	43·95	99·0	90·5	88·3	90·2	92·0	94·8
7	35·16	114·1	106·5	110·0	111·4	110·5	110·8
8	28·12	138·4	122·6	132·1	133·4	131·6	126·8

It will be seen that this table, notwithstanding discrepancies arising from imperfect observations, decidedly indicates the following law as obtaining at the limit of distinct visibility,—at least for dark objects seen on a bright ground, viz.—that *while the distances of the eye diminish in a geometrical ratio the corresponding distances of the light increase in an arithmetical ratio.* In other words *the distance of the light is a logarithm of the linear magnifying effect.*

One remarkable result of this law is that a small fractional change of a faint light possesses as great efficacy to balance a given magnifying effect as a large fractional change of a much brighter light. Thus, in the above table, calling the brightest illumination unity, we have the illumination at the second station less than $\frac{1}{4}$. Here therefore over $\frac{3}{4}$ decrease of the light is required to balance a magnifying effect of $\frac{5}{4}$. But, in the next step, from the second to the third, the same power $\frac{5}{4}$ is balanced by a decrease of only about $\frac{5}{9}$ths of the light and, in the step from the last but one to the last, the same $\frac{5}{4}$ths of power is bal-

anced by less than $\frac{1}{4}$th the decrease of light. In this last case therefore the fraction of decrease is less than one-third the first. This exhibits an exact accordance with the following remark made in Sir John Herschel's Outlines of Astronomy, Art. 780,—and derived, I suppose, from a general comparison of the ordinarily accepted stellar magnitudes with photometric results,—"the eye (in the absence of disturbing causes) does actually discriminate with greater precision between the relative intensities of feeble lights than of bright ones, so that the fraction $\frac{3}{4}\frac{6}{9}$, for instance, expresses quite as great a step downwards (physiologically speaking) from the sixth magnitude [of stars] as $\frac{1}{4}$ does from the first."

Admitting, then, that this law holds equally as true for bright points seen upon a dark ground as for dark points seen upon a bright ground, it is easy to indicate the *principle* upon which the maximum visibility, attainable in given circumstances by increase of magnifying power, can be realized,—at least for distinct objects (as in the microscope), and for all focal images, except as affected in their distinctness by aberrations. For, in the above series, suppose the illumination at station 4, for example, to obtain in a telescopic field, and the view directed to circular dots of the same apparent magnitude as in that observation. Then suppose another eye-piece to increase the magnitude $\frac{5}{4}$, it will reduce the former illumination to $\frac{1}{2}\frac{6}{5}$. This is also, very closely, the diminution found from station 4 to station 5 in my experiments. Therefore visibility (at least when limiting distinctness is the question) is here at a maximum. If a third eye-piece were substituted, giving a second $\frac{5}{4}$ increase of dimension, the light would be a second time reduced $\frac{1}{2}\frac{6}{5}$, while the experiments show that visibility cannot be maintained with less than $\frac{2}{3}\frac{5}{6}$. This eye-piece therefore would be in defect of light by the ratio of unity to the fraction $\frac{9}{1}\frac{3}{0}\frac{}{6}$.

The application most immediate to my object yet remains—and may be expressed, in substance, as follows:—suppose the illuminated ground, say of No. 4 in the table to be the disc of a planet, as viewed by an eye-piece, and the disc of a star to present a *contrast* of light much greater than that of the dark spots viewed in that experiment—yet not to be visible because not subtending a sufficient angular dimension. It follows that the field illumination, being at its maximum already, will be progressively darkened by successive augmentations of magnifying power; while, on the other hand, the stellar disc may advance toward visibility and finally acquire distinctness. Perhaps, in strictness, the total field of illumination should be considered angularly *constant* under all the changes of magnifying power, as that condition was probably an accident of the observations above tabulated,—although not recorded in my minutes,—nor am I certain that it is of essential import.

ART. III.—*Views and Suggestions on the Practice and Theory of Scientific Publication;* by Lieut. E. B. HUNT, Corps of Engineers, U. S. A.

IT is much to be regretted that physical investigators labor under so many and serious disqualifications for the successful prosecution of their researches. In addition to such hindrances as result from the stern necessity of procuring a livelihood, there are many others which do not seem necessary, and which still effectually obstruct that progress towards new truth by which the man of science measures success. Not least among these adverse circumstances is the almost universal fact that the man of science has not the command of those books, and special memoirs, in which are recorded the methods and results of anterior investigations. Except in the rare cases of conjunction between science and wealth, there is a perpetual inability to compare the research in hand, with the great body of related researches of the past and present times. It is scarcely possible that one's theme should be entirely his own property, and except in this rare case it is very needful that he should have habitual access to all records bearing on his particular line of research. Now this is utterly impossible, unless the investigator lives in convenient proximity to some one of the principal libraries. There is not yet in this country any single library at all equal to the entire demands of our whole body of investigators, and the two or three which are slowly approximating to this position of scientific catholicity are only very partially available beyond the charmed circle of an easy walk. In making a birds-eye examination of from 6000 to 7000 volumes of scientific memoirs and periodicals. &c., while gathering materials for an Index of References to be published by the Coast Survey, I have been more and more impressed with the vast affluence of the published wealth of science, and of the capacity of the many thousands of memoirs and articles passed in review, for a strict classification under specialities. It is entirely a safe assertion that no specialist, however restricted his speciality, is fully cognizant of all the published matter relating to his field:—and also, that without this full knowledge of labor and thought already expended, he must be wasting much of his own strength in doing again what others have completed. In point of fact, most of the active truth-seeking minds of this country are compelled to work on, remote from the chief central depositories of books and memoirs, happy if from their limited private resources they can secure as a private possession that carefully chosen minimum of special treatises which will give a starting point somewhere near the front line of actual research and discovery. Nearly all such isolated

effort is expended too much at a venture to bear the fruit of discovery to which it ought and is entitled to aspire. Not one in twenty of the members of this Association has the command of all those special records of research, which are needful to the symmetry and completeness of his own labors. There may be in the Astor Library a dozen closely related memoirs of which a specialist knows the existence, and a dozen more of which he has never heard, but if he must journey some thousands or hundreds of miles, at his own cost, to study them from 10 A. M. to 5 P. M., he is fortunate if he can use them on these conditions. The result is that only a few amongst us are able to do as we should, had we a complete library within easy reach. Such is nearly the universal truth concerning those who are by nature endowed with the faculties requisite for successful research. It cannot therefore be entirely profitless to consider what possible alleviations of this condition are practicable.

First then, it is a fixed tendency of scientific research, to subdivide during its progrees into numerous and well defined specialities. Each new branch of investigation soon subdivides into other and more limited branches, and though all are ultimately derived from one grand trunk, so vast that not even the giants of mind can span its circumference, still the special branches have a narrowness of diffusion which brings them quite within the compass of a single scientific mind. It thus happens that though many thousands of separate memoirs or investigations are preserved in the aggregate records of science, the pure specialist will find but few which are related to his own chosen field; so few indeed that could they be bought separately at the ordinary prices for printed matter, he might without harming his fortunes, possess as his own the essntial materials for a complete study of his speciality. If however he attempts this solution of his wants he is at once confronted with the fact that this small group of memoirs cannot possibly be purchased without buying in connection, the very costly series to which they severally belong. For the most part the series of scientific memoirs are grouped together without reference to subject, in a most illogical congeries, having only the date and the publishing society in common. Hence the specialist, when outside the limits of easy access to a complete library, must rely almost entirely on separately published special treatises for his knowledge of what has been done, and the original memoirs of the master minds must be forbidden treasures.

It is however obvious that such a lame condition of things is not one of original necessity, but has grown out of the history of scientific publications. If we go back to the times preceding the existence of Academies of Science, we find nothing answering to the scientific memoir. The Academies, formed from those

who were rich in ideas, but poor in purse, first found that by associating the limited wealth of a number, the great result otherwise denied, could be attained. When too they assumed an imposing exterior through the lustre of great names, the condescensions of patronage intervened, and the luxuries of type and engraving began to be lavished on the volumes in which their proceedings and choice memoirs were published. As science expanded its domains and augmented its small array of followers, academies sprang up in profusion and in ever increasing numbers, until now they have outrun the knowledge of even the most learned librarians. Nearly all academies have published or now publish volumes of memoirs which are the tokens of their vitality to all not within the chosen band. Wherever strong discovering minds have elaborated their researches the volumes of memoirs are enriched with treasures of close reasoning, sagacious insight, and results laboriously attained. These memoirs are still fresh with the vigor of original thinking, and cannot be spared, as part of the training of future discovering minds. When original memoirs give place in the studies of investigators to bald abstracts, feeble analyses, or popularized digestions, these investigators will grow sinewless, and discoveries, if made at all, will come despoiled of all their proper grandeur. We cannot too strongly deprecate the tendency even among specialists, to know the labors and investigations of original scientists only through abstracts and synopses, or general reports. These are indispensable aids for the knowledge of the immense related areas outside of one's speciality which he can only expect to know at second hand, and in the briefest method, but they are not among the legitimate means of advancing the boundaries of his own special field. Direct resort to original records is the prime condition on which the symmetrical and well furnished culture of specialists must rest.

In the true and philosophical sense of the word, most of the printed scientific memoirs cannot be said to have been published. Publication implies something more than mere printing. It involves the idea of circulation or diffusion among the whole group of kindred minds specially interested in the particular subject matter. A memoir on electro-magnetism, for instance, is not published when it is printed in the St. Petersburg Bulletin, because very few of those specially prosecuting electro-magnetic researches, habitually see this Bulletin. It is possible that nearly all of this class will see somewhere, a bald announcement that Lenz has after many experiments come to such and such conclusions; but this leaves them almost as much in the dark as before. Each memoir has its special public diffused over all lands where science is cultivated, and is only fully published, when it has reached the whole of this public. In some instances, this spe-

cial public would number less than a hundred, in some others it would be many thousands. To all not members of its own proper public, any special memoir is as an utterance of unknown tongues, and however much they may reverence they cannot duly appreciate it. If therefore a Society or Academy has procured the printing of a valuable memoir, it has the great matter of publication still left to attend to, so long as those specialists throughout the world for whom the memoir is really meant, are not duly supplied with printed copies. A memoir may nearly as well not exist, as to be printed and not properly circulated. As a matter of fact a large proportion of the most valuable printed memoirs have never been published at all. There is enough science buried in the documentary files of our general and state governments, to furnish out a long series of volumes. These scientific waifs are scattered broad-cast among politicians, and their constituents, but the humble devotee of science who spends years of labor in like researches, vainly strives to possess himself of a copy. In such cases, myriads of copies may be printed, and yet the memoirs are not published. On the other hand, if there be a special memoir on a subject which only ten men have studied or will study, the supplying each of these ten with a copy is a complete publication.

A great portion of the failure to publish printed memoirs is clearly consequent on the mode of publication. Nearly every academy prints its own proceedings and memoirs, aided by citizens whose local pride is enlisted in the promise of scientific distinction. With the printing however the matter is prone to end, there being no effective mode of publication. Scientific periodicals in like manner, though far more generally published than academic memoirs, are still limited to a small and inadequate circle of subscribers, and beyond this circle, they are in effect not published.

It will be evident on reflection, that the great desideratum for the correction of the evils indicated, is a *universal publishing agency* for all scientific memoirs printed by the societies, academies and periodicals of the entire scientific world. Without at all interfering with the formation of regular library files, by society donation or purchase, as is now done, such an agency would have enough to do in supplying all specialists with their special memoirs. The expansion of this idea into practical form would of course rest on the concurrence of all the societies, &c., which publish memoirs. I can perhaps most clearly indicate its workings by supposing the agency established; its system might be briefly this.

An agency is duly organized and guarantied to the world, by being placed under the control of a Board, or well established Institution or Society. The agent puts himself in correspond-

ence with all the societies which publish memoirs, and after fully explaining the objects of the agency makes arrangements with each Society to print a given number of separate copies of each memoir issued, making what might be called the specialists edition. The society might either furnish these copies at the cost of manufacture, or at a fixed price, or if it is able, it might donate them. Thus the universal agent will be supplied with unbound copies of each memoir. He is all this while supposed to be corresponding with all the specialists, for the purpose of ascertaining what class of memoirs each one may desire. He will soon be able to supply printed lists of titles, whereby each investigator can know what memoirs, just published, or announced as forth coming, he may desire. Thus a perfect understanding of the relation between supply and demand might be attained. This being all done and the agency fully supplied, Prof. A. B. living anywhere, orders a given number of particular memoirs at prices indicated in the list. He has only a limited surplus of means to bestow, but he can thus supply his exact wants at the minimum cost and without having to buy a large number of memoirs he does not want. The result will be that Prof. A. B. in a town remote from large libraries, can proceed in his chosen studies with all the aids needful for placing himself in advance of the known, and thus becoming an effective discoverer. The main object would be, not profit to the agency, but simply to give demand a free and full opportunity to call upon supply. As far as is now possible without reprints, the memoirs hitherto published would be included in the range of operations. An author publishing a special memoir in a periodical, by sending copies to such an agency would be sure of their going to the right persons. It is likely that many economical reprints might in time be justified. The main idea would however be to ensure the proper publication of new memoirs as they are printed. Such an agency ought not to be an ordinary commercial agency, without guarantee of its continuance, but it should rest on a firm basis, so as everywhere to deserve and possess confidence.

There are laws of political economy underlying the philosophy of publication which have been too little regarded in scientific issues. They have mostly been issued on the plan of large prices and small circulation. The right plan is a maximum circulation and a minimum paying price. There are enough ready to buy almost any special memoir to authorize its being sold at low prices. If however a large price is affixed it becomes at once prohibitory. Such publications as Taylor's Scientific Memoirs, and Liebig and Kopp's Reports ought not to be expected to succeed at such prohibitory prices as they bore. All that is necessary to ensure success to the principle of minimum paying

prices and maximum circulation is simply to organize the demands of scientists throughout the world so as to ensure to each specialist a chance of purchasing precisely what he wants, at fair rates. By doing this, scientific progress will be immensely stimulated and the poor barriers of cliques, nations, languages, and races will be swept away before the widely diffused liberalities of truly cosmopolite science. If the imperfect glimpses towards some vital generalities which I have now essayed, shall lead to a more correct appreciation of existing evils and to active reflection on the possible meliorations in the condition of the scientific body, my purpose will be fulfilled.

ART. IV.—*Chemical Analysis of Faröelite and some other Zeolites occurring in Nova Scotia;* by HENRY HOW, Prof. Chemistry and Nat. Hist., King's College, Windsor, Nova Scotia.

THE minerals described in the present communication were obtained from the trap rock of the Bay of Fundy, which is well known to mineralogists, particularly of America, as having yielded, especially at the point of land called Cape Blomidon and the region and the northern shore opposite, Partridge Island, a great number of beautiful zeolitic minerals. In excursions to another part of the same formation not so frequently visited, namely, the shore of Annapolis county, lying a few miles to the west of Blomidon, I met with some species, namely, faröelite, mesolite and epistilbite, which are not generally considered to occur in Nova Scotia, and indeed the first two, having somewhat recently been separated from others as true species, in Europe, have not I think been hitherto distinguished among the minerals of America. The analytical results now to be brought forward may possess an interest not only as indicating the existence of these minerals in North America, but also as strengthening their claims to the title of true species, which has been given them chiefly on the ground of chemical composition. In addition, an analysis is furnished of an unweathered specimen of laumonite, long known as occurring among the Acadian zeolites but met with only in certain districts of the Fundy shore affording them.

Faröelite.—This zeolite, which has long passed as a variety of scolecite, under the name of mesole, has recently been carefully studied by Dr. Heddle, of Edinburgh,* and the results of his investigations have led him to consider it a distinct species; he has accordingly named it anew, and in this I think he has done

* Edinb. New Phil. Journal, 1856, vol. iii, p. 351.

well, inasmuch as the designation he has chosen marks at once the individuality of the mineral and the locality affording him the material for the experiments upon which he has based his conclusions. The description given of its characteristic appearance and association is this:* "It occurs associated with mesolite but still always distinct from it, being in implanted and isolated globules or hemispheres sometimes overlaid but never underlaid by the mesolite. The color is usually bluish-white and the lustre decidedly pearly, not glassy like the mesolite."

I met with specimens having in every particular the foregoing characters, in the trap cliff in the neighborhood of a small fishing village called Port George, in Annapolis Co., N. S., and from having obtained some dozen specimens in the course of three or four hours' search for minerals, I have little doubt of its being tolerably abundant in that locality. The hardness of the mesole of Berzelius is stated to be 3·5, the specimens of the Nova Scotian mineral, whose analysis is given below, had hardness =4·5; very thin laminæ of it, which it afforded very easily, twisted before the blowpipe and in a good heat fused to a glassy enamel; it gelatinized perfectly with HCl before and after ignition. The analytical numbers I obtained are collated with those of Heddle from the Skye mineral; my first two analyses were on air-dry material, the third on that dried over HSO_4:—

	Scotland, Heddle.			Nova Scotia, How.		
	I.	II.	III.	I.	II.	III.
Soda,	5·77	4·38	5·33	5·00	3·75[a]	5·58
Lime,	11·54	11·40	9·82	11·70	11·92	11·52
Alumina,	28·44	30·00	29·30	29·31	29·98	29·52
Silica,	41·32	41·20	43·17	41·41	41·48	40·90
Water,	13·26	13·20	12·40	12·83	12·87	12·49
	100·33	100·18	100·02	100·25	100·00	100·01

[a] By deficiency.

It will be seen at once that the results are very concordant, and that we have the same combination in both cases. The oxygen ratio deduced for RO, R_2O_3, SiO_3, HO is very nearly $1:3:5:\frac{8}{3}$ upon the average of the analyses, and Dr. Heddle writes as the formula of faröelite,

$$NaO\,SiO_3,\ 2CaO\,SiO_3+3Al_2O_3,\ 2SiO_3+8HO.$$

which requires the percentages,

Soda,	5·74
Lime,	10·37
Alumina,	28·57
Silica,	41·96
Water,	13·34
	100·00

* Fourth Supplement to Dana's Mineralogy, in Am. Jour. Sci., July, 1857, p. 118.

In the course of criticism Dana remarks,* "that the ratio of oxygen in Heddle's second analysis is rather $1:3:4\frac{1}{2}:2\frac{1}{2}$ (that of a hydrous nepheline) $=RO_2SiO_3+2Al_2O_3SiO_3+5HO$ (in which $2RO=\frac{2}{3}NaO+1\frac{1}{3}CaO$) = silica 40·25, alumina 29·83, lime 10·84, soda 6·00, water 13·08=100." My analyses would agree rather better with these percentages than with those of Heddle's formula; but still, as Dana says, "probably the preceding is the true ratio for the mineral," and, moreover, the recorded analyses† of nepheline do not give more than two per cent of lime.

Mesolite.—The mineral mentioned as the associate of faröelite, viz., mesolite, is very much the more abundant of the two, forming the larger proportion of specimens in which they occur together, and it is found not only in this association but filling per se cavities in the amygdaloid. It would also appear to be very frequent throughout the formation in the same neighborhood, and is sometimes met with in very large masses; I procured the remains of one, said by the owner, who gave it me, to have been found in a cavern on the shore since filled up, and to have been originally larger than a man's head; the piece I obtained was about the size of two fists, the crystals of which it was made up into a compact mass were from two to three inches long and translucent when separated, the specimen was homogeneous, or nearly so, having only a little stilbite attached to it, but was impressed with the form of a very large crystal of analcime; its analysis is No. I. below. Mesolite is said to be also very abundant on the North Mountains of Annapolis, some distance away from the shore; the form prevalent, from a specimen of my collecting being recognized there as very common by the owner of that last named, is an opaque white mineral in large masses of very close texture, having a finely fibrous radiated and penniform structure; this specimen furnished the results II. below. The third analysis is of a specimen found by myself at Port George; it was associated with faröelite in a reniform mass, and when broken up the fragments appeared nearly transparent and the aggregated crystals were prismatic.

	Dried at 212°.		Dried over HSO_4.	
	I.	II.	III.	Calculated.
Soda,	5·21	4·45[a]	5·68	5·29
Lime,	9·63	9·63	9·55	9·57
Alumina,	25·92	27·04	26·68	26·36
Silica,	46·84	46·48	46·71	46·46
Water,	12·11	12·40	11·42	12·30
	99·79	100·00	100·04	100·00

[a] By loss.

These results agree very well with the percentages placed in juxtaposition which are calculated from the formula

$$NaOSiO_3,\ 2CaOSiO_3+3(Al_2O_3SiO_3)+8HO,$$

* Loc. cit.

† Nicol's Mineralogy, p. 140.

given by Heddle* as that of "mesolite," and also by Berzelius† as representing the constitution of "lime-and-soda scolecite."

It is interesting to observe on comparing this formula, which includes those of two of scolecite and one of natrolite, with the formula of faröelite, that they differ in containing respectively three atoms of a monosilicate, and one atom of a sesquibasic silicate of alumina, combined with the same groups of elements, thus:

$$\left.\begin{array}{l} 2(CaO\,SiO_3 + Al_2O_3SiO_3 + 3HO \text{ scolecite}) \\ NaO\,SiO_3 + Al_2O_3SiO_3 + 2HO \text{ natrolite}) \end{array}\right\} =$$

$$= NaO\,SiO_3, 2CaO\,SiO_3 + 3(Al_2O_3SiO_3) + 8HO \text{ mesolite,}$$

$$NaO\,SiO_3, 2CaO\,SiO_3 + 3Al_2O_3, 2SiO_3 + 8HO \text{ faröelite,}$$

and I am inclined to think that, in the case of minerals occurring in such intimate association as these, when there is a choice of formula equally according with the results of analysis, that one is preferable which shows some such simple relation, and therefore that Heddle's formula is more probably the correct expression for faröelite than that of a hydrous nepheline before mentioned.

Epistilbite.—I found this species very generally accompanying a very fine variety of stilbite on ledges of trap at Margaretville, a village about seven miles east from Port George. The stilbite was in large transparent colorless broad columnar aggregates and the epistilbite in small reddish-colored rhombic crystals nearly or quite opaque. Although the former is by far the more plentiful the latter was present in considerable quantity on some specimens and on few that I collected was it altogether wanting; sometimes it appears to form the only lining in shallow cavities of the rock of this locality. A portion of the mineral detached from stilbite gave these results on analysis:—

NaO	KO	CaO	Al_2O_3	Fe_2O_3	SiO_3	HO
0·99	0·99	7·00	15·34	1·58	58·57	15·42=99·89

I met with the same substance on a specimen of honey-yellow stilbite in the cabinet of King's College, Windsor, N. S., among some minerals labelled "Nova Scotian," but the precise locality of this one was not marked: in this case it was so intimately mixed with calc-spar as to render mechanical separation impossible; its analysis which follows shows on this account some carbonate of lime,

NaO	KO	Al_2O_3[a]	SiO_3	CaO	CO_2	HO
2·02	*trace*	16·10	56·13	9·53	1·54	14·36=99·68

[a] With a little Fe_2O_3.

after deduction of this accidental ingredient the essentials become,

* Edinb. New Phil. Journ., liii, p. 351.
† Fourth Supp. to Dana's Min., loc. cit., p. 127.

NaO	CaO	Al_2O_3	SiO_3	HO
2·10	7·87	16·73	58·35	14·93=100·00

and the results agree very well with the preceding from the Margaretville mineral, and also with those of an analysis of an Iceland epistilbite by Kurlbaum, viz:—

NaO	KO	CaO	Al_2O_3	Fe_2O_3	SiO_3	HO
2·05	0·19	7·81	17·10	0·12	58·74	14·21=100·23

The formula for epistilbite given by Berzelius is

$$(RO\,SiO_3+Al_2O_3\,3SiO_3)+5HO,$$

and if $RO=CaO$ the corresponding percentages are these,

CaO	Al_2O_3	SiO_3	HO
9·17	16·78	59·32	14·73 = 100.

The analyses recorded above would give for RO, $\frac{1}{4}NaO+\frac{3}{4}CaO$ leading to the formula

$$NaO\,SiO_3,\,3CaO\,SiO_3+4(Al_2O_3\,3SiO_3)+20HO,$$

which requires the percentages,

NaO	CaO	Al_2O_3	SiO_3	HO
2·49	6·76	16·49	58·78	14·48 = 100.

Laumontite.—This mineral is very abundant at Port George, occasionally veins of three inches thickness are seen intersecting the sides of the cliff: a portion from the interior of a mass, gave these numbers, in the air-dry state—

CaO	Al_2O_3	SiO_3	HO
12·07	21·64	51·43	15·26 = 100·44,

which correspond well with the percentages,

CaO	Al_2O_3	SiO_3	HO
11·85	21·76	51·14	15·24 = 100,

calculated from the usual formula,

$$3CaO,\,2SiO_3+3(Al_2O_3\,2SiO_3)+12HO.$$

The crystals agreed in all respects with the published descriptions. At Margaretville laumontite occurs colored green by copper.

ART. V.—*The Climate and Productions of Ponape or Ascension Island, one of the Carolines, in the Pacific Ocean;* by L. H. GULICK.

PONAPE, or Ascension Island, is situated in latitude 6° 55′ N., longitude 158° 25′ E. It is one of the five "high" islands of the Caroline range, in that part of Oceanica now so significantly called Micronesia. It is highly probable that Quirosa discovered it in 1595, on his way to Manilla from his unsuccessful attempt at colonizing on Santa Cruz. It is conjectured by M. de Freycinet that the Hogoleu group was that seen by Quirosa; but the description given is that of one large island of thirty leagues

circumference, which much more readily suggests the connected appearance of Ponape, than the random islets scattered in the immense lagoon of Hogoleu. As favoring this supposition I may mention M. Duperrey, as shown in his chart of the Caroline Islands (Hyd. Fr., No. 715, No. 33). It is only necessary to compare either Duperrey's or D'Urville's chart of Hogoleu, with Lutké's of Ponape; particularly the "views" of the two groups, as given on the margin of the charts.

There are several native traditions which render it certain that the island was seen by civilized voyagers during the seventeenth and eighteenth centuries, and during the first quarter of the nineteenth, without anything having been added to the vague discovery by Quirosa. Rear Admiral Lutké, of the Russian corvette La Seniavine, re-discovered Ponape, Jan. 2d. 1828. He remained in its vicinity three days, then proceeded westward adding more largely than any other individual to our knowledge of the Caroline range.

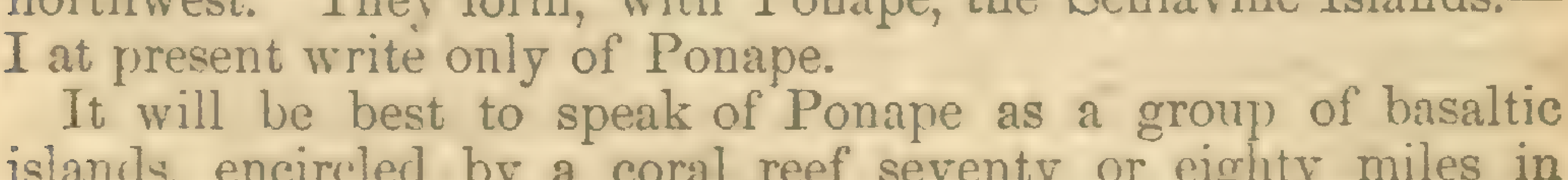
I have, as yet, been so unfortunate, in my extreme exclusion from "the world," as not to meet with the narrative of the Seniavine's voyage, and do not know how much, or what, may have been gleaned from this island by Kittlitz and the other members of the scientific corps of that expedition, and consequently have not been able to correct and assist myself by their reports.

There are two neighboring "low" or coral islands named *Aut* and *Pakin*, distant respectively ten miles southeast, and twenty northwest. They form, with Ponape, the Seniavine Islands.—I at present write only of Ponape.

It will be best to speak of Ponape as a group of basaltic islands, encircled by a coral reef seventy or eighty miles in circumference. A large island covers nearly the whole of the enclosed area, and is named Ponape, so giving name to the whole. Twelve or more basaltic islets, more or less distinct from the main island, add much to the scenery of certain parts of the group, and somewhat increase the area of habitable land.

Geography and Geology.

The following sketch of the island as seen from the east, is taken from the margin of Admiral Lutké's chart of Ponape.



THE EAST SIDE OF PONAPE.

The height of what Lutké named Mt. Santo, is given by him as 2,858 feet. Several other points approach it in elevation. A somewhat continuous range of hills extends from *Uu* of the *Wa-*

neka tribe, westward to *Paleka*, of the *Jekoits* tribe. The terminations of the range are somewhat gradual slopes. The general line of the range is that of a curve, convex southward. The eastern third, or perhaps half, is narrow and almost equally precipitous on the northern and southern aspects, presenting in many places, as in *Uu*, perpendicular faces of rock of great height, that show strong columnar tendencies. The middle third of the range slopes very gradually on the southern aspect, where the mountains maintain a comparatively regular descent from their summits to the ocean shore, a distance of five or six miles. Several long narrow valleys run up these slopes, along the sides and at the heads of which are many faces of columnar rock, over which leap the most romantic of cascades. Again, the western portion of the range is narrow and precipitous.

A number of detached hills and short ranges still further diversify the scene, more particularly the following. Midway between the *Metalanim* harbor and *Aru* point, there rises a very high hill, of perhaps a thousand feet, which sends westward a low prolongation that connects it with the main central range. Again, on the north of the island, in the *Nut* tribe, there rises a similar mountain, but barely connected with even the mainland. At this place the most perfect basaltic columns are found. The central ridge of *Nut* is but a prismatic mass, and about its base lie scattered columns of great length, also detached piles of agglutinated columns. This must have been, I think, at least one of the spots whence the materials for the Metalanim "Ruins" were taken.

By the course of the main range and the positions of the subsidiary hills, two broad and long valleys are formed. One of them may be called the *Metalanim*, the other the *Nut* valley. Each of them may be four to five miles in width, and six to eight miles in length.

There are several solitary projections of rock in the Metalanim and Kiti tribes. One, much resembling a sugar-loaf in shape, in the Metalanim valley at the head of the harbor of the same name, is called *Takain*. Its height may be four hundred feet, and its circumference at the base three-quarters of a mile. Its eastern aspects are perpendicular; its western, not so steep but that by adhering with hands and feet, after the manner of the indigenous Gecko, it may be ascended. Adherent to the base of the main rock, yet separated from it above, is a much smaller rock. Within a quarter of a mile of Takain rises a dome-shaped hill, of almost the same elevation, but not so precipitous. (No. 19, 20.) At the head of the *Panian* harbor, a needle-shaped rock elevates itself from the top of a slight ridge. It may be ten or twelve rods at the base, and perhaps 150 feet high above the top of the ridge. On Lutké's chart it bears the

name *Mt. Guerite.* In the west end of the island is another needle rock, which I have never visited, much like *Mt. Guerite.*

A number of very active streams pour through the valleys on the southern side of the island. The largest is probably that emptying at the base of Takain. On the north of the central range there are no streams, save one or two draining the Nut valley. These streams, during the course of ages, must have effected great things. I question whether any bodies of water in the world are more active than these. During freshets, which occur with almost every heavy shower, they are deeply perturbed by the black and red earths with which they are laden. These alluvial substances are deposited along the shores, forming in many places immense flats, over which the tide ebbs and flows. It is only on the south side of the island, from the Metalanim harbor to Point Kittlitz, that these marshes are of any considerable extent, for on this side alone are the principal streams, and these southwest shores are protected from the roughened ocean acted upon by the northeast trades. The island at the mouth of the Nut valley is but one of the alluvial marshes.

The insulated basaltic points about the main island of Ponape are very interesting features of the group. *Mutõk*, or Mt. Tenenedos, as named by Lutké, is in reality an island, being only attached to the main land by an extensive alluvial marsh. It is a sort of double hill rising very precipitously on its eastern aspect 150 or 200 feet. *Jekoits* island is an irregular triangle, each side being perhaps a mile and a half. Along the eastern border, running north and south, is a high ridge 800 or 1000 feet in height, exœedingly precipitous. The northwestern part of the island is elevated from 150 to perhaps 250 or 300 feet and along its northern and western shores presents very precipitous ascents. The columnar tendency may be seen in most of the ledges of this island, though perfect prisms are rare. The Rev. Mr. Doane resides on the northern margin of the western portion of the island, upon the edge of the precipice, up which a tolerable path has been formed by taking advantage of this columnar arrangement and removing successive blocks. *Lungur* and *Poitik* are but points of columnar basalt, 100 feet or so in height with a talus about their bases, their circumference at the water's edge being perhaps half a mile. *Parum* is about a mile and a half in length, and in one place a half mile in width, with a central ridge that may be at points 300 feet in height. The *Mants* rise very abruptly from the water's edge. The smaller is a sort of dome, though presenting in many places faces of perpendicular basalt. About its eastern shore are considerable hillocks of coarse conglomerate. (Specimens Nos. 4, 5.) The larger Mant is but the crest of a ridge of prismatic rock

that along its whole western aspect presents a very precipitous face, and may be in one place 300 feet high. *Tapuk* is but a repetition of the same, of less elevation. *Takain* rises with much of the usual perpendicularity to the height of perhaps 300 feet. The mass of its hill is of a reddish rock (No. 14). And in certain spots a red earth is found that makes an admirable paint for native canoes (No. 12); a substance that is also found in almost every part of the main island. *Mutokaloj* is about 50 feet in height, and is very small. Only on the margins of this islet have I succeeded in finding anything approaching to cellular lava (No. 8). *Taman* island has a general level of about 75 feet, and descends quite steeply to the water on nearly every side. Near it, to the south, are several very small and low basaltic islets.

It need scarcely be remarked that the general surface of all the basaltic members of the Ponape group is very rugged. Rocks and stones are scattered over almost the entire surface in the greatest profusion; and but few plains, even of a few acres in extent, are to be anywhere seen. The leeward slopes in the *Kiti* tribe present a few spots that may be termed level. Basaltic specimens may be found on almost every square rod of the island, but on certain spots they seem to be adventitious rather than native. In such spots the earth is a reddish clay, under which will usually be found what seems to be a decomposed rock (No. 11), with frequent seams of red earth (No. 12). Beneath the whole, we strike upon the substratum of basalt, in compact masses.

I send, accompanying, a number of *mineralogical specimens*, which I trust some one will describe for publication at the same time with what I write. I cannot but think that the very compact nature of all the island structures will be remarked with interest. Do not many of the specimens present almost the appearance of uninterrupted igneous rocks?

My principal object of geological inquiry has been for positive evidences of what I suppose may be specifically termed *volcanic action*, viz., the products of volcanoes and craters themselves. About the eastern shore of Mantapeti we find a conglomerate which I presume I am right in supposing attributable to volcanic action (Nos. 4, 5). So also at Shelong (No. 7). About Mutokaloj I find scoriaceous lava (No. 8). But as yet I have not been able to fix my eye on anything which in my ignorance I can recognize as a crater. Several of the hills have at a little distance, clothed as they are with luxuriant vegetation, that regular dome or cone-shaped contour which I suppose one feature or variety of isolated craters; but, on close inspection, faces of perpendicular basalt may almost always be found, which, with the absence of terminal bowls is I presume decisive against their

being craters. The Rev. Mr. Doane has called my attention to the appearance of the eastern terminus of the central range. The very end or point of the hills just as they reach the shore opposite to the *Mant* islands, seems as though removed by a gorge, leaving a semicircular area with steep sides, in some places 150 or 200 feet high. May this be a crater with one part of its periphery destroyed, or is it only an accidental termination? The certain detection of craters must be left for my future study, or for better instructed investigators.

Surrounding the whole body of basaltic elevations is a beautiful coral reef, distant from the coast of the main island the average distance of perhaps two miles. There are no less than seven considerable intervals in the continuity of this reef, forming as many harbors, several of which are really excellent ones. Between the reef and the shore of the island are all the usual coral patches that give such wondrous variety to tropic waters. The height of these patches varies greatly. A very considerable number of them are from an inch or two to a foot or more above the ebb tides at the syzygies. On the outer reef are a number of islets in every way similar to those on the purely coralline groups. They are found from the mouth of the Metalanim harbor, along the southern line, as far as point Kittlitz, but not on the north of Ponape. These islets have a nearly uniform elevation of about two feet above high-water mark. I gather from my own observations and from the reports of the pilots, that soundings are found outside of the reef, nearly if not quite round the island, at distances varying from a quarter to half a mile from the reef.

Mr. Hale, philologist of the U. S. Expl. Exped. under Com. Wilkes, has advanced the supposition that Ponape, in common with Kusaia (also called Ualan and Strong's Island), and other Caroline islands, has undergone a depression of several feet within a few centuries, that is, since the erection of the celebrated "Ruins" near the Metalanim harbor. (Report on Ethnography and Philology, p. 87.) Were Mr. Hale's suppositions regarding the original position of the Ruins on dry land correct, the evidence would be decisive of an important subsidence within a comparatively recent period. But I am well satisfied the structures maintain very nearly, if not exactly, the same relation to the ocean they did on their first erection. There is not, that I find, any evidence of accumulating sands about their bases, as would be the case had there been a subsidence. And again, the habits of the people would lead them to select just such a submerged position for the easier ingress and egress of their canoes, to which they are so attached as vehicles of travel. For a fuller exposition of my views on this subject I must refer to a paper on "The Ruins of Ponape." That Mr.

Hale should have suggested this hypothesis is not surprising considering the reports he had received. A personal inspection would, without a doubt, have influenced his mind as it has that of every intelligent observer. In my remarks on this topic I do not overlook the fact that the coral island regions are, in general, areas undergoing depression. The investigations of Mr. Darwin, with the further illustrations of Mr. Dana, are decisive on this point. I only question the supposition of any subsidence since the erection of those structures we denominate "the ruins." In this connection I may mention the tradition that there once existed a small islet at the mouth of the Metalanim harbor, to the north of the entrance, which had trees upon it, but which no longer exists, having been carried away by a great wave in the days of the grand-fathers of the present generation. Such little changes are continually taking place, one islet being formed at the expense of another. They are, I think, not at all indicative of subsidence. Earthquakes are unknown in Ponape.

Climate.

I first give a tabular view of meteorological observations. The decimals are the result of the observations having first been made with a "Centigrade" thermometer, and afterwards reduced to Fahrenheit. No one will fail to mark the astonishing uniformity of temperature. It may be doubted whether there exists a table exhibiting a greater. The mean daily range is about 10°; the mean difference of successive months a scarcely appreciable quantity; and the mean annual temperature 80·28°. The extremes during three years were 89° and 70°—a range of only 19°, and the lower limit was reached on only one extraordinary day, the 31st of March, 1853. Omitting the record of this day, the extremes are 87·98° and 73·76°, making the range but 12·78°, which is nearer the true average.

We may challenge the world to rival the uniformity presented in the following table, unless it be at other islands in this Micronesian Ocean. Surrounded by an immense expanse of water, and situated near the equator, the temperature could scarce be different.

The prevailing winds are "the trades" from the northeast. They blow most vigorously during the northern winter, while the sun, in southern declination, permits the farthest southern oscillation of the trade wind zone. During the summer, the trades retire to the north, leaving the island to "the variables." Yet, there is much difference between different seasons. There are times when the trades are light during the whole winter, but continue with great uniformity during the summer, as in the year 1856. The suggestion that there may be cycles in the operations of the trades seems not an improbable one. It is to be hoped that they may yet be studied out.

A Summary of the Meteorological Observations during 1853, '54, *and* '55, *on Ponape, by Mrs. Louisa Gulick.*

	Thermometric Conditions—Fah.							Udiometric Conditions.		Winds.				
	Mean at Sunrise.	Mean at Noon.	Mean at Sunset.	Mean.	Max.	Min.	Range.	Clear days.	Dys lig't showers.	Showery days.	Rainy days.	Days of Trade Winds.	Days of Var'bles	Calm days.
1853.														
January, ..	78·00	85·00	82·00	81·50	88·00	75·00	13·00	15		10	6	..	..	..
February, .	76·00	84·00	81·50	80·33	86·00	73·00	13·00	6		8	14	..	..	..
March, ...	75·55	84·58	80·46	80·19	89·00	70·00	19·00	11		10	10	..	..	..
April, ...	75·41	83·86	80·10	79·53	86·00	71·00	15·00	6		17	7	..	..	..
May, ...	73·74	83·54	80·87	79·38	87·00	72·00	15·00	1		13	16	..	..	..
	m'n at 7 A.M.	m'n at 12 M.	m'n at 9 P. M.											
July, ...	76·95	82·73	78·09	79·25	86·54	75·00	10·54	2		11	7	..	..	..
August, ...	77·52	84·95	70·64	77·70	88·88	74·48	13·40	9		19	3	..	..	..
September,	77·36	84·50	79·70	80 52	88·52	75·20	13·32	14		13	3	..	..	..
October, ...	77·66	83·11	79·09	80·02	87·44	75·20	12·24	11		17	3	16	15	..
November,	77·40	83·75	78·81	79·98	86·72	74·30	12·42	12		17	1	17	12	1
December, .	80·15	82·56	80·87	81·19	85·64	77·00	8·64	9		20	2	..	31	..
1854.														
January, ..	79·14	81·89	79·24	80·09	83·12	75·38	5·74	11	9	10	1	29	2	..
February, .	80·01	82·58	80·26	80·95	85·40	75·56	9·84	16		11	1	28	..	..
March, ...	79·26	82·83	80·54	80·87	86·90	75·56	11·34	11		18	2	23	8	..
April, ...	80·62	83·23	81·28	81·71	85·64	76·64	9·00	10	2	17	1	29	1	..
May, ...	80·57	83·16	80·92	81·55	86·72	75·20	11·52	4	2	23	2	29	2	..
June, ...	78·49	83·72	79·91	80·70	85·64	74·84	10·80	9	6	11	4	22	8	..
July, ...	78·24	79·49	75·46	77·73	86 00	75·20	10·80	9		20	2	11	11	9
August, ...	77·39	83·66	78·80	79·95	86·36	74·48	11·88	8	2	19	2	7	24	..
September,	77·36	83·30	79·34	80·00	86·00	74·48	11·52	10	4	14	2	11	16	3
October, ...	77·90	84·38	79·16	80·48	86·36	75·74	10·62	12	12	6	1	6	10	14
November,	77·54	82·22	79·70	79·82	85·64	74·52	11·12	5	3	13	3	15	15	..
December, .	79·52	83·30	79·88	80·90	85·64	75·56	10·08	12	3	12	2	29	1	..
1855.														
January, ..	80·06	82·22	80·06	80·78	83·66	76·46	7·20	21	5	3	2	..	..	..
February, .	79·70	83·66	80·96	81·44	87·80	77·00	10·80	20		8	7	..	..	..
March, ...	78·80	81·50	78·44	79·58	83·48	73·76	9·72	11	2	8	9	..	..	..
April, ...	79·52	83·48	79·88	80·76	86·36	75·20	11·16	11	7	9	8	..	..	..
May, ...	78·44	83·30	80·06	80·93	86·90	75·56	10·34	12	2	8	8	..	..	..
June, ...	78·44	85·46	79·70	81·20	87·20	75·92	11·88	9	2	14	4	..	..	..
July, ...	77·36	83·12	79·16	79·88	86·36	74·48	11·88	4	5	20	1	..	..	..
August, ...	....	....	....	....	....	....	....	4	3	6		..	..	..
September,	77·72	84·02	78·98	80·24	87·98	75 20	12·78	10	3	15	1	6	24	
October, ...	78·08	84·02	80·06	80 72	86·36	75·56	10·80	13	3	13	2	20	11	
November, .	78·08	83·66	79·34	80·36	85·46	74·84	10·62	17		9	4	19	5	6
December, .	80·42	82·22	80·42	81·02	....	....	....	7		5		31	..	..
Average of 1853.	76·90	83·81	78·56	79·75	89·00	70·00	19·00	96		155	72	....	..	..
Average of 1854.	79·17	82·81	79·54	80·50	86·90	74·48	11·52	97	42	174	23	239	98	26
Average of 1855.	78·78	83·33	79·73	80·61	87·98	73·76	12·78	139	32	118	35	....	..	..
Average of Three years.	78·28	83·31	79·27	80·28	89·00	70·00	19·00							

Electric Conditions—1853.—*July*, thunder and lightning, 1 day; *Aug.* thunder, 1 day; *Oct.*, thunder, 6 days; *Dec.*, thunder and lightning, 4 days. 1854.—*March*, thunder, 1 day; *April*, thunder, 2 days; *May*, thunder and lightning, 1 day; *June*, thunder and lightning, 1 day; *July*, thunder, 2 days; *Aug.*, thunder, 1 day; *Sept.*, thunder and lightning, 1 day. 1855.—*March*, thunder, 1 day; *Aug.*, thunder, 1 day, and smokiness for several days; *Sept.*, thunder, 1 day; *Nov.*, thunder, 4 days.—Average of 1853, 12 days; of 1854, 8 days; of 1855, 7 days; of three years, 28 days.

The tornadoes or typhoons, so common among the strictly "South Sea" islands of the Pacific, and about the Bonin Islands to the north, may be said to be unknown here. Yet some of the very oldest inhabitants tell of a gale having swept the island during their early youth which destroyed the breadfruit and cocoanut trees so completely that a great famine ensued, by which a very large number perished. This was probably a "cyclone." And it is worthy of remark that the same thing is said to have occurred at nearly the same distance in the past, on Strongs Island, (lat. 5° 19′ N., long. 163°6′ E.), and with similar effects. It was probably the same cyclone that dealt destruction to both islands.

The humidity of this island is marked, yet equable. During the summer we are ever and anon covered by that cloud-zone which has been recognized as lying between the trade-wind zones, and which vibrates north and south with the sun and with the trades. The summer is our rainy season; yet situated as we are under the northern boundaries of the cloud-zone even during its farthest oscillations northward, we are by no means deluged with rain, as are many tropical localities. There are many intervals—sometimes of several weeks—of the most delightful weather during all the summer months. The trade-wind season, during the northern winter, is the driest portion of our year; but it never brings that parching heat which is the usual accompaniment of a "dry season." The trades reach us from their long ocean voyage, so deeply fraught with moisture that the impingement of their clouds on our hills of nearly 3000 feet, together with the slight reduction of temperature occasioned by the dense clothing of vegetation that completely envelops the island, secures oft repeated precipitations. And the island is of so small extent that the showers pass readily over to the leeward slopes, and water them equally with the windward. During the year 1856, when, as above noticed, the trades were light during their own appropriate season, yet intrusive during the whole summer, the island experienced a drought greater than any remembered by the oldest inhabitants. Yet even during that year the universal green was scarcely at all diminished. It may not be misplaced to call attention to this fact that the Northern Pacific generally participated in the meteorological perturbations that were so wide spread through all the northern hemisphere during 1856.

Thunder and lightning are rare and faint. It is a significant fact, that the natives have seen so little destruction by lightning that in the few instances which have occurred they never suspected its agency.

Plants.

Ponape is clothed with vegetation from its highest peaks quite into the ocean, and so dense is it that a passing vessel can

scarcely discern a house of the hundreds that are scattered along its entire circumference; and but for the smoke of domestic fires and the canoes gliding with magic sail and paddle within the encircling reef, the island might readily be thought uninhabited. The whole island is but an uninterrupted forest, with the exception of a few spots on the leeward slopes that are covered with a short coarse grass, whose green is of quite a yellow cast, and contrasts strongly with the intensely deep—almost black—green of the surrounding thickets. These grassy areas embrace from 3 or 4 to 50 or 100 acres. The soil of these spots is a very compact, reddish—almost ochreous—clay.

The growths of heavy timber are by no means confined to the dry land, but extend far out on to the coral flats, wherever the alluvial deposits before mentioned are lodged, there forming very extensive mangrove swamps, in which are found several kinds of trees, but principally varieties of the *Rhizophora*. These marine trees are themselves active agents in promoting the accumulation of alluvium, their numerous adventitious roots conservatively detaining the mobile particles. The area of these swamps is yearly extending; the intervening spaces between different patches, that form so many creek-like passages, being continually lessened; and the outer coral flats are becoming more and more green, particularly since the desolations by small pox in 1854, as fishing parties have much less actively and numerously trampled the flats to the prejudice of the rapidly germinating mangrove.

The luxury of vegetation gives a peculiar softness to the scenery of this otherwise rugged island. But the dead uniformity of its unbroken, sultry, green, must I think detract much from its romantic beauty, as compared with many tropical islands. Nor does the uniformity pertain only to color;—even the circumstances of varying height and form are apparently denied to the different tribes of trees, so completely does the mantling canopy of vines bind tree to tree, bridge every slight hiatus, and blend every peculiarity in one gently undulating flood. With the exception of two or three varieties of palms, that occasionally skirt the shore like the cocoanut, or stand in princely distinctness like the sago, the eye vainly seeks for something in form or altitude to relieve the luxurious scene.

There are several representatives of the family *Aroidæ*. Some of them in the damp forests run up to the height of trees, and send out branches, and may be climbed. The stems, or rather aerial portions of the root, of those that the natives name *Ot*, but whose scientific designations I cannot determine, make a very palatable and nutritious food, especially in times of scarcity. Several varieties of the *Arum esculentum* grow wild, and are occasionally eaten, but they are of an inferior quality, compared with

the *taro* of the Hawaiian Islands. Only one of them can deserve much attention, and this is very coarse grained and dry.

The natives distinguish no less than six varieties of *Saccharum*. I cannot give their scientific designations, if indeed they are all named. They are distinguished by the color of their cuticle, which is an index to the various degrees of compactness, juiciness, and sweetness of the interior. One variety, of a light yellow, I have been informed by an intelligent native of the Isle of France, is the same kind that makes the best sugar on that island. Good syrup has been made by the same individual on this island. With his rough and ill-adapted apparatus, one gallon of sap produced $1\frac{1}{2}$ quarts of syrup.

The genus *Pandanus* is represented by at least two varieties. It is possible they should both be denominated *P. odoratissimus*, for it is true that the fruit, if not the male flowers, are very pleasingly fragrant. I should prefer however to call one of them *P. esculentus*. On this island, as on all the "low" islands of at least Eastern Micronesia (which comprises the Kingsmill, Radack, and Ralick Ranges,) the female spadices are highly esteemed, and even carefully preserved, as important articles of food. A large portion of each drupe is pulpy and sweet, and no doubt highly nutritious, and, to one accustomed to them, certainly quite as palatable as sugar cane. No one having visited Micronesia would remark of the *Pandanaceæ*:—"It can scarcely be said that the plants of this order are of any known use to man, except as furnishing, in common with many others, a good material for thatching." This variety of the *P. odoratissimus* which I term *esculentus*, grows alone on the sandy atolls. The leaves of both varieties, but particularly the upland, are used on this island for the construction of curiously plaited mats.

The *Dioscorea* (yam) is extensively cultivated. There are several indigenous varieties, some of which grow wild and are of indifferent eating, being very fibrous, while others are cultivated and are the finest of esculents. At least one variety of wild yam, eaten only in times of famine, needs from its bitterness to undergo a process of maceration to be made nutritious;—if this be not an exception, I do not know of there being any poisonous species of the *Dioscorea* on the island. A number of varieties of yam now found on the island are spoken of as foreign. The most of them have been introduced since ships began to visit the island; though some were brought from other groups of Micronesia by straying companies in their ship-like canoes.

The natives distinguish eight or ten varieties of *Cocos nucifera*, (cocoanut) depending on the character of the nut. The inside husk of the nut of one variety is considered sweet and edible by the natives, for which it is more valued than for the contained water and meat. The cocoanut thrives wherever planted

on every portion of the island; though the usual localities are along the shores and on the coral islets.

The leaves of what must I think be a species of the *Sagus* are used for thatching. It is usually found in quite moist localities. It stands perfectly erect and spreads its magnificent tuft at the maximum height of perhaps 75 feet. The surface of its fruit is broken into lozenge-shaped spaces which are so arranged as to remind one of scale armor. From a slight experiment it seems probable that sago can be procured from it.

A plant very nearly allied to the *Areca Catechu*, if it be not indeed the genuine betel-nut tree, is occasionally to be seen. The natives frequently chew the unprepared nut, but never combine it with lime and betel leaves, as in the East Indies, and as even on an island so near as Yap, lat. 9° 35′ N., long. 138° 8′ E.

A species of *Tacca* is scattered about the island, and might be made a considerable article of export. It is peculiarly abundant on the Aut Group.

The genus *Zingiber* has at least one representative here. Its root-stocks have much of the aromatic property peculiar to the genus, and are used by native practitioners for cataplasms.

Of the *Musa* (banana), there are many varieties;—neither Malabar nor Sumatra can boast of more; fifteen or twenty may be mentioned. The general remark will readily hold, that their fruits are not of the most delicate kinds, though the most of them can in various ways be so prepared as to be very palatable and important articles of even civilized diet, and at least two varieties will hold their place among the most luxurious of tropic fruits—specimens of the veritable *Musa paradisiaca*. I cannot certainly determine whether we have the particular plant of the Philippine Islands named *M. textilis*, but it is interesting, that several varieties here found produce a fibre that cannot be distinguished from the Manilla hemp. The natives have from time immemorial known how to prepare and variously dye this fibre, which they weave into very tasteful and durable belts, that are worn by the men bound about the body just over the umbilical region, above their cocoanut-leaf skirts. One variety, of which little care is taken, produces only abortive fruit, yet compensates for its sterility by furnishing what the natives deem an edible stem, quite tender and sweetish, and slightly nutritious.

At least one variety of the *Lauraceæ* is found here. It must, from its sensible properties, be a species of *Sassafras*, but I have no means of determining its specific designation. Considerable quantities of the bark of its stem have at different times been taken by traders to the Hongkong market.

The *Piper methysticum* grows luxuriantly, and is most assiduously cultivated. It sometimes runs up to the height of fifteen or twenty feet. The natives distinguish two varieties:—one

having a dark green stem spotted black, the other a very light green bark even yellowish. I think it is palpably less acrid and actively narcotic than the *P. methysticum* of Eastern Polynesia. The natives make most extravagant use of it as a narcotic beverage. The roots are pulverized, water added, and the juice expressed through fibres of the *hibiscus* bark. Some chiefs drink quarts of this daily, yet the only results are a temporary drowsiness that passes away after a doze of an hour or two, a diminished appetite, and sometimes a slight nausea and gentle retching. Nothing is ever seen of the peculiar desquamating effect upon the cuticle reported as the results of *ava-drinking* on the Hawaiian Islands. I conceive that the peculiar narcotic principle of the plant may be less concentrated in this humid climate than in the dryer regions of the Pacific Ocean.

The *Artocarpus*, (breadfruit) is the great food-producing genus to the inhabitants of Ponape. Without it they would starve, or be reduced to the dire necessity of slight labor for their sustenance; with it, no lords of creation are more independent. It forms most extensive groves, even forests. It is cultivated with all the little care it requires, and also grows wild over every portion of the island. The months of the northern summer are those during which the great harvest is gathered. There is another slighter crop in the winter or trade-wind season; and scattering trees may be found bearing during every month of the year. The crop is a somewhat uncertain one. The same trees seldom bear well two successive seasons; and an excess of moisture, as well as drought very sensibly affects it.—I have at hand nothing extended on this genus as studied where the species are more numerous than here; but I think the native classification of it interesting. They distinguish three principal divisions, which may perhaps be termed species, principally though not exclusively based upon the character of the fruit; a classification which I cannot but think more philosophical than that depending on the very accidental condition of integrity or incision of the leaf. 1. The *Mai mat;* that which is commonly called Jackfruit. The fruit of the *mai mat* is rough and very irregularly oval, and produces large seeds. The peculiar characteristic is that when ripe it can be eaten raw, its more delicate varieties being, to those accustomed to it, as palatable as custard. The leaves of some varieties are deeply lobed, of others not at all. It grows almost exclusively on the shady atolls of the outer reef; and it may be remarked that it is the *mai mat* that is found on all the coral islands of East, if not West, Micronesia. 2. The *Mai'n jarak.* The leaves of the greater number of varieties of this species are deeply incised, while some are most emphatically *integrifolia.* The fruit is usually prolately spheroid, and very symmetrical. One variety alone produces seeds. The

principal characteristic of this species is the roughness of the fruit occasioned by the pointing of the coherent sepals of each floweret. The number of distinguishable varieties of the *mai'n jarak* is astonishing. I have the names of over fifty! Nor are the marks of distinction merely fanciful. They are principally found in the peculiar qualities of the fruit. 3. The *Mai'n iwa.* Its leaves are both lacerated and perfect. The foliage and bark are less hirsute, and of a slightly lighter green than those of the *mai'n jarak.* The fruit is more spherical than that of the *mai'n jarak.* In the fruit of the *mai'n iwa* the flowerets are more closely blended, both interiorly and exteriorly, than in either of the other species. From this results an extreme smoothness of the rind, and a compactness of the fruit even to the very interior fibrous stem of the spike, that are characteristics strikingly different from the fruit of the *mai'n jarak,* where each floweret is not only distinct at its free extremity on the surface of the fruit, but also again at its base about the interior stem; and most especially different from the *mai mat,* where the degree of adhesion between the flowerets is at its minimum, there being scarce sufficient agglutination to connect the flowerets of a spadix into one point. The specific terms *incisa* and *integrifolia,* I would unhesitatingly reject. If the *mai'n jarak* be not already included in the species *Artocapus hirsuta,* (which I suppose not, from the two varieties of rough and smooth bread-fruited *A. incisa* being mentioned,) I would suggest that such names be given to the three species as shall designate the differing degrees of adhesion of the pistil-bearing flowerets.

The *Mangifera* has one representative, in a tree that bears a fruit certainly not unpalatable on an island so destitute of tart fruits, but which is quite fibrous, and not to be compared to the *Mango Indica.*

One plant of the genus *Citrus* grows wild. It bears a fruit about two and a half inches in diameter, which no one will be liable to confound with the *Pomme d'Adam.* Its rind is thick, quite aromatic when ripe, and very bitter. The interior is coarse, dry, and also somewhat bitter. I know not whether it be best designated as a *C. aurantium,* or *C. bigaradia.*

Animals.

There are only three species of indigenous *Mammalia.* 1. A small *dog,* not more than eighteen inches in height and proportionate length. Its hair is long and sleek, its ears short and erect. The posterior hairs of the tail as it curves upward are peculiarly long, which gives it quite a bushy appearance. It is a sprightly but unintellectual variety, worth little save as a companion and as food for a degraded race of men, and as furnishing retreats for the lice their masters deem such a delicacy.

2. *Rats.* The variety here found is a peculiarly disgusting kind, and is very numerously represented. They are very destructive in gardens, rooting up the seeds of all leguminous plants, and even devouring young chickens and attacking setting hens. 3. *Bats.* The natives distinguish two varieties, a large and a small; but I am not satisfied that the cause of difference is anything but age. The largest individuals will measure eighteen inches from tip to tip.—*Whales* and *porpoises*, are comparatively numerous in the surrounding seas.

Of *Birds* there are twenty-nine or thirty species. They are distributed *probably* in the following proportions among the different orders, as clsssified by Swainson. 1. Of the *Raptores*, one species, a small *owl.* 2. Of *Insessores*, fourteen or fifteen species. The Dentirostral species number eleven or twelve. I do not know of any Conirostral, or Tenuirostral. There are two Fissirostral, a *kingfisher* and a *nightjar;* and one Scansorial, a small *parrot.* 3. Of the Natatores there are six species; one that may be a *sea-duck*, the rest *gulls*, one of which is the *Phæton.* 4. Of the Grallatores, one *plover*, one *sand-piper.* 5. Of the Rasores, two *Columbidæ*, the *Ptilinopus cyanovirens*, and the *Carpophaga oceanica;* and a small partially domesticated *fowl.*

The number of individual *Reptiles* is great, though confined to a few species. At least two species of turtles are found in our waters, the *Chelonia mydas* and *C. imbricata.* They visit the uninhabited Aut Group to deposit their eggs. The so-called "tortoise-shell" forms an export of some value. There are several species of the *Lacerta* group, and these constitute the main body of the island Reptilia. We have one variety of what I suppose may be an *Iguana;* and also a *Gecko.*

I need scarcely remark that the varieties of *Fishes* are very numerous;—and more than this I will not attempt to report. A fresh-water *eel* is an object of great veneration and fear. A species of harmless *shark* is very abundant. A large *sting-ray*, (probably a *Trygon*,) frequents the coral flats and is the occasion of much fear to wading fishermen.

Insects are somewhat numerous, but are probably distributed through a comparatively small number of genera. I think the remark will hold that the orders Coleoptera, Hemiptera, Orthoptera, Homoptera, Neuroptera, and Lepidoptera, in particular, are not numerously represented. *Cockroaches* and *dragon-flies* are the largest insects we have. One species of small *white ant*, is a source of some trouble. There are six or more kinds of true *ants*, that are not however of the more intrusive and destructive kinds. The cosmopolitan *house-flies* and *fleas* are found, but are not troublesomely numerous. *Musquitoes* are bred by myriads in our swamps.

Of the *Arachnida* I can only say—that a few varieties of *spiders* are found, and among them there is one whose feet when extended cover a surface of three inches diameter; and that a small *scorpion* is occasionally seen, though not at all feared.

The *Crustacea* and *Mollusca* are numerous and attractive, but it is little I can as yet report concerning them. Without having done more than induce the natives to collect for me, I have on my shelves about a hundred species of shells. A small *squid* is eaten by the natives. One species of *Nautilus* is drifted ashore, always in a mutilated condition. The natives suppose it to be a fallen star! I am surprised that as yet I have discovered but six or seven of the terrestrial Pulmonifera, a group very abundantly represented at the Hawaian Islands. Of the Conchifera I have fifteen or twenty species.

Of the *Radiata* I only know that our waters are alive with them. Twelve or fifteen species of the *Holothuria* are found, though the varieties most valued in China are comparatively scarce. *Biche de mer* has several times been cured here by foreigners for the Hongkong market.

Art. VI.—*Contributions to Analytical Chemistry;* by Henry Wurtz, of New York City.

On the Detection of Nitric Acid in solution, with Observations on the Action of Sesquisalts of Iron upon Indigo and Metallic Gold, and on the Neutralization of the Colors of Metallic Solutions.

(Read, with experimental illustrations, before the American Association for the Advancement of Science at Baltimore, 1858.)

In the course of an investigation now in progress, the first part of which has already been presented, I have had constant occasion for a good practical method of determining with certainty the presence or absence of nitric acid in small quantities under all possible conditions. The different methods that have been devised for the accomplishment of this important qualitative operation were therefore submitted to examination, and the results obtained seem worthy of being presented in a collected form. The following are the most important of these methods.

1. The *protosulphate of iron test*, or method of Richemont. This depends upon the well-known reddish or purplish-brown color produced by the combination of the nitric oxyd formed by the deoxydation of free nitric acid by proto-compounds of iron, with the excess of the iron compound. H. Rose, in the last edition of his Handbuch,* ranks this test above all the

* I, 659.

others, and certainly, when manipulated as there directed by Rose, Richemont's test is scarcely surpassed in delicacy by any other; and when the liquid to be tested is colorless, it is extremely convenient; but unfortunately the color produced has too little about it that is *characteristic*, and is therefore not certainly recognizable in the presence of many other colors that are of very frequent occurrence. When the quantity of nitric acid is minute, this test requires also a very considerable *length of time*, an important objection.

2. The *iodine test*, or method of Higgin,* dependent upon the setting free of the iodine of iodid of potassium by free nitric acid, and formation of the blue starch compound. When no other free acid than the nitric is present, this mode may be made very delicate and reliable, but when in combination, the nitric must be set free by the addition of sulphuric acid, and as Gay-Lussac long ago observed, sulphuric acid alone gives with a solution of iodohydric acid, or, which is the same thing, with iodid of potassium, free iodine, by the following reaction, $SO^3+HI=SO^2+HO+I$.† Even in dilute solutions this appears to take place after a time, and when but traces are to be tested for, it is difficult to be certain whether the free iodine indicated is due to nitric acid or to this reaction. With great care, however, I believe that this method may in some cases be made useful, particularly when *free* nitric acid is to be tested for.

In the presence of the least trace of a *sesquisalt of iron*, this method is especially fallacious, a fact which has I believe heretofore escaped attention. I find that a deep blue color is immediately produced when but a minute trace of any such compound is present. In fact, the conclusion that I have drawn from experiment is that a mixture of iodid of potassium and starch solutions when used as a test for sesquioxyd of iron in solution, yields in delicacy and sensitiveness to no other mode now in use, and I wish therefore to propose it as a new method of detecting the presence of small quantities of iron. The reaction takes place both in neutral and acid solutions; with sesquichlorid of iron it is of course as follows,

$$Fe^2Cl^3+KI=2FeCl+KCl+I.$$

3. *Schæffer's test;* presented to this Association by G. C. Schæffer at the New Haven meeting in 1851.‡ It depends upon the conversion of the nitric into *nitrous acid* by the action of metallic lead, and then treating with yellow prussiate of potash and acetic acid, when a deep golden yellow color is developed. This test is extremely delicate, indicating, according to Schæffer, the presence of saltpetre in 60,000 parts of water. As however

* Chem. Gazette for 1850, p. 249.

† Gmelin's Handbuch, I, 689.

‡ Am. Jour. Sci., [2], xiii, 117; Liebig und Kopp's Jahresbericht für 1851, 625.

the nature of the yellow compound formed is not precisely known, much less the character of the reaction that takes place, we have no data from which to infer how the presence of other substances, particularly of metallic salts, would modify the result, and I should accordingly hesitate to rely upon it without much previous investigation.

E. W. Davy has since given a somewhat similar process,* dependent on the formation of a *nitroprussid* by heating with yellow prussiate and chlorohydric acid, adding an alkaline carbonate when cold, and then sulphid of ammonium to the filtrate, to produce the familiar brilliant purple color, by which he detected the 200th part of a grain of saltpetre. It is desirable that this beautiful method should be fully examined, and the modifying influences of all other substances determined, a work which would require much time and labor.

4. The *brucine test.* This depends on the deep blood-red color given by brucine in contact with free nitric acid, and is lauded as extremely sensitive by Fresenius in his last edition.† It is necessary to success, however, that the nitric acid should be in a certain state of concentration.

5. The *gold test;* founded upon the power of mixtures of nitrates with chlorohydric acid to dissolve *gold leaf,* by virtue of the chlorine set free, the gold being afterwards detected in the solution by protochlorid of tin.

An observation of a very surprising and unexpected character made in connection with this mode of testing may be appropriately introduced here. I found that solutions containing sesquioxyd of iron (no nitric acid whatever being present) have the power to dissolve gold. A solution of pure sublimed sesquichlorid of iron was boiled with a fragment of gold leaf. The liquid soon became turbid, from deposition of a basic chlorid, as is always the case with neutral solutions of ferric salts, but on acidulating with chlorohydric acid, it cleared up and the gold had disappeared. Another fragment also dissolved, and so on. The action is accompanied by the production of protochlorid of iron, as is easily shown by a solution of ferridcyanid. On filtration, dilution, and treatment with sulphohydric acid, the precipitate obtained in the liquid had quite a dark brown color, and when washed, dried and burned on platinum foil, left a residue easily proved to be spongy gold by burnishing in an agate mortar.

A solution of pure ferric sulphate was also proved to dissolve a little gold, though less readily than the sesquichlorid, and to be reduced to ferrous sulphate. Even at the ordinary tempera-

* Lieb. and Kopp's Jahresb., 1853, p. 654.

† "Diese Reaction ist ungemein empfindlich." Fresenius's Anleitung zur qualitativen chemischen Analyse, Braunschweig, 1856, p. 175.

ture a solution of the sesquichlorid, standing for several days in contact with gold leaf, gave a green tinge with the red prussiate, indicating reduction. An acid solution of the sesquichlorid is also partially reduced by digestion for a few hours on the sand-bath with clippings of *platinum* foil. The solutions of gold are not affected by refrigeration, concentration, dilution or filtration.

I cannot find that this action of gold and platinum upon ferric solutions has been announced before. If observed, it may have been attributed to traces of nitric acid or chlorine still remaining in the liquid, a cause of fallacy not existing when the sublimed sesquichlorid is experimented with. Metallic silver, however, has been observed to reduce ferric salts. Gmelin says, "metallic silver takes up oxygen from a boiling aqueous solution of the sulphate of sesquioxyd of iron so that sulphate of silver and sulphate of protoxyd of iron are formed; in the cold, metallic silver precipitates again and the solution contains only sulphate of sesquioxyd of iron as before."*

It is evident that this behavior of gold vitiates entirely the gold test for nitric acid in the presence of iron.

6. The *indigo test.* This familiar method needs no description. When chlorohydric acid (or chlorid of sodium, as recommended by Liebig†) is added, the bleaching is undoubtedly due to the production of free chlorine, just as the solution of gold under the same circumstances was proved to be by Gay-Lussac.‡

All the five methods previously mentioned depend evidently upon the *production* of a color not previously existing in the liquid, and which in many cases may be produced by the presence of other substances besides nitric acid, whilst the indigo test depends upon the *destruction* of a color previously existing, this color being at the same time a very characteristic one, seldom found in solutions, and belonging to a very stable compound that is well known to be affected only by the most potent oxydizing agents. It seemed to my mind therefore that, other things being equal, the indigo test possesses elements of greater certainty than the others, and furnishes stronger *positive* evidence of the *presence* of nitric acid, though some others may give stronger proof of its *absence.* I set myself at work therefore to investigate the indigo test, and ascertain the circumstances which can modify its action.

I quickly discovered, as announced in a former paper, with surprise I must admit, that like the gold test, it is wholly fallacious in the presence of compounds of *iron.* A solution of pure neutral sesquichlorid of iron was found to bleach indigo powerfully, with formation of protochlorid. The iron solution used was freshly prepared from green crystals of the sublimed ses-

* Gmelin's Handbuch, i, 128. † See H. Rose's Handbuch, last edition, i, 664.
‡ Liebig and Kopp's Jahresb., 1847–8, 389.

quichlorid.* Excess of chlorohydric acid does not affect the result. A solution of pure ferric sulphate made by evaporating the sublimed sesquichlorid with excess of pure sulphuric acid until free from chlorine, also bleached indigo powerfully; and when a small excess of indigo was added so that the liquid had a perceptibly bluish tint after long boiling and cooling, crystals of pure chlorid of sodium being added produced no further change after renewed ebullition, thus showing that the bleaching power of the sesquisulphate is little, if any, inferior to that of the sesquichlorid. Red prussiate indicated also in this case a reduction to ferrous sulphate.†

When iron then is present in a liquid to be tested by indigo, it is necessary to precipitate it first, and test in the filtrate after addition of excess of acid. For this precipitation I have recommended in a previous paper the use of *ammonia*, but since that was written the idea has occurred that the presence of ammoniacal salts may possibly interfere in some way with the reaction, although it may be difficult to understand how. An experiment however, in which two parallel trials were made, everything else being equal, but in the one case a large quantity of sal-ammoniac (free from iron) added, seemed in its result to justify this apprehension. It is *safer*, therefore, until this point is more distinctly determined, to precipitate the iron in every case with *carbonate of soda*. And when ammoniacal salts are already present the ammonia may easily be expelled by evaporation with excess of carbonate of soda before testing.

Besides ferric solutions, the following substances were found to have the power of bleaching indigo.

Terchlorid of gold, after evaporation to dryness with a large excess of chlorohydric acid, to remove all possible traces of nitric acid, gave a solution which bleached indigo very largely when boiled with it, gold being reduced and deposited, partly as a metallic mirror upon the sides, and partly as a black powder at the bottom, of the test tube. When boiled with a large excess of indigo so as to remain still blue, then filtered and the blue color destroyed by nitric acid, the liquid was not affected by sulphohydric acid, and no longer contained therefore any gold.

Bichlorid of platinum, freed in the same way from all nitric acid, bleached indigo powerfully, with production of a very deep

* It was observed that such a solution, after exposure to the *light* for some weeks contained traces of protochlorid, confirming an observation of Osann to the same effect (Lieb. and Kopp's Jahresb., 1855, p. 406). Such a solution must therefore be kept in the dark. I may remark here also that it is advisable not to *filter* such a solution through paper, as it was found, after standing for a short time in contact with purified filter paper to give a green color with the red prussiate.

† It may be added here that some other vegetable colors were tried, such as acid solutions of litmus, logwood and cochineal, and found to be likewise readily decolorized by sesquichlorid of iron.

brown color (protochlorid of platinum) no precipitate being formed.

Bichlorid of tin, made by passing chlorine gas through a solution of the protochlorid to saturation, adding some chlorohydric acid, evaporating to dryness and heating the residue until it volatilized strongly in white fumes, to expel all excess of chlorine; gave a solution which bleached indigo readily and copiously even *in the cold*. Acidulation with chlorohydric acid did not affect the action.

Pure *arsenic acid*, having been evaporated in solution twice with chlorohydric acid to ensure absence of nitric acid, left a crystalline residue which still contained much arsenic acid, for its solution gave with nitrate of silver the brick-colored precipitate, but which apparently retained also chlorohydric acid in some form of combination. On boiling the aqueous solution of the residue with indigo solution no bleaching action could at first be obtained, but on addition of a little chlorohydric acid the blue color, though slowly and with some difficulty, vanished.

It is scarcely necessary to remark that all substances which evolve chlorine, iodine or bromine, with muriatic acid, will also bleach indigo, such as KO^3, BaO^2, Ce^2O^3, the *chromates*, the *deutoxyd* and salts of the *sesquioxyd of manganese*, *manganates* and *permanganates*, *chlorates*, *perchlorates*, *iodates*, *bromates*, *deutoxyd of lead* and the *sesquioxyds of nickel* and *cobalt*.

A mixture of deutoxyd of manganese with dilute sulphuric acid bleaches very strongly.

There are a few other substances which interfere, although in another way, with the reaction. These are those bases which give precipitates with the sulphuric acid of the indigo solution, such as *baryta*, *strontia*, *lime*, and *oxyd of lead*. Such precipitates, by making the liquid milky, render the change of color during the bleaching less discernible; and moreover, it was found that the indigo, being insoluble in other acids, all goes down with the insoluble sulphate, so that the filtered liquid is colorless. These bases are readily removed, however, at the same time as the iron, by precipitation with carbonate of soda and filtration, before applying the test.

I now come to a class of difficulties which at first sight seemed less easy to obviate. These are the cases in which the *color* of the liquid to be tested approaches more or less to that of the indigo solution itself. This occurs with solutions of *cobalt*, *nickel*, *copper*, *chromium* and *uranium*. The mode devised for overcoming this was perfectly successful in every case. It consists of an expansion of the happy idea of Dr. Gibbs (founded upon an observation of Mauméné*) in applying Crum's test for manganese to cobalt and nickel solutions, and has been repeatedly alluded

* Liebig and Kopp's Jahresbericht für 1850, 156.

to in a former paper. Some further details, however, of a special character are necessary here.

The chlorids of cobalt and nickel are used reciprocally, after the manner of Dr. Gibbs, to neutralize the colors of each other. The color of the mixture, as I have obtained it, is when concentrated rather *grayish* than *brownish* as it is designated by Dr. Gibbs.* This slight residual color is however of no consequence, as all that is necessary is to get rid of all admixture of *blue* tint, before adding the indigo solution. In working with cobalt solutions it must be carefully borne in mind that the ordinary rose colored hydrate of chlorid of cobalt is converted *in solution* into the blue anhydrous chlorid by admixture with strong chlorohydric acid, or even with the dilute acid on heating, so that in the application of the indigo test to a mixture of chlorids of cobalt and nickel, on heating to effect the bleaching, the liquid usually assumes a blue color deeper than it had before. If nitric acid is present, however, on cooling the hot mixture by addition of a little cold water, or better by a current of cold water on the outside of the test tube, the blue color wholly disappears.

The green colors of solutions of copper, chromium, and uranium are neutralized in the same manner as solutions of nickel, with chlorid of cobalt. In the case of copper it must be remembered that, as Gladstone has shown,† chlorid of copper, like chlorid of cobalt, differs in color according to the quantity of water it is combined with, being in dilute solutions *blue*, but on admixture with strong muriatic acid or on heating, assuming a peculiar *greenish* tint. Now it is only the *green* chlorid which neutralizes the chlorid of cobalt, so that it is necessary to have sufficient muriatic acid present to ensure the existence of the copper salt in the green modification, at least while the liquid is *hot*. The color produced is then very similar to that obtained with the chlorids of cobalt and nickel. In the green-yellow solution of chlorohydrate of uranic acid, the green tint is perfectly obliterated by chlorid of cobalt, a light *salmon* tinge being produced which does not interfere with the indigo test. A solution of chlorid of chromium is precisely similar in its action to one of chlorid of nickel, the resultant color with chlorid of cobalt being *identical* in appearance. A concentrated green solution of

* The chlorid of cobalt used was chemically pure, having been prepared by the elegant method recommended by Gibbs and Genth in their late "Researches on Ammonia-cobalt bases," (Am. Jour. Science, [2], xxiii, 260,) which consists in igniting the violet crystals of the *chlorohydrate of purpureocobalt*, dissolving the residual mixture of chlorid and sesquioxyd of cobalt in dilute muriatic acid and expelling the excess of the latter by evaporation. The solution has an extremely rich rose color. The chlorid of nickel used was also prepared with care, and was of high purity.

† Lieb. and Kopp's Jahresb. 1855, 414.

protochlorid of iron is also rendered almost completely colorless by a little chlorid of cobalt, but this is of course a matter of no importance in connection with the indigo test.*

In conclusion, to describe the general *mode of manipulation* which I adopt, having found it to add materially to the delicacy and reliability of the test. The liquid to be examined is treated,

* A few other observations were made upon the effects of mingling colored solutions. The nitrates of cobalt and nickel when mixed in proper proportions neutralize each other just as the chlorids do. With the chlorid of nickel and the nitrate of cobalt the neutralization is probably more perfect than when the two chlorids are used. With chlorid of cobalt and nitrate of nickel the resultant color was rather brownish than grayish. The nitrates of copper and cobalt did not seem to be entirely complementary, for on gradually mixing their solutions, the red color of the excess of the cobalt compound began to appear before the blue of the copper solution had entirely vanished, giving a violet tinge to the mixture. On adding a little muriatic acid, however, the copper became converted into the green modification of the chlorid, and every trace of blue disappeared leaving the liquid with the peculiar gray color. With nitrate of copper and chlorid of cobalt also, no perfect neutralization could be effected, but the same gradual passage of one into the other presented itself. Addition of muriatic acid however produced the same effect as before. These observations, and others that I have made, have an obvious bearing upon the question of the manner of interdistribution of two acids and two bases in a solution together, and promise to furnish us with a new and valuable means of investigating this important problem. The subject will therefore be resumed at a future opportunity.

There does not seem to be much present prospect of devising any substitute for the expensive chlorid of cobalt for nullifying blue and green colors, at least in the indigo test. The color of the *manganese* chlorid is too feeble. *Permanganic acid*, which approaches in color to cobalt solutions, is of course inapplicable. Some experiments with permanganic acid gave, however, interesting results. On throwing a little chameleon mineral into very dilute acetic acid, a rich amethyst-colored solution is immediately formed, with effervescence from escape of oxygen. This solution destroys the green color of chlorid of nickel as perfectly as chlorid of cobalt, the resultant tint moreover being extremely similar; with chlorid of chromum in certain proportions an approximate color was produced, but in whatever proportions the two were mixed, a trace of residual red or blue was always left; with chlorid of copper a fine deep violet-blue color, like that of the ammonia-sulphate, was produced.

I desire here to urge upon the attention of chemists this general subject of the mode of interference of colors with each other when in admixture. It seems to me to present a wide and highly promising field of research, the exploration of which would lead to valuable practical results, and probably furnish us with explanations of many phenomena at present considered obscure. Indeed, results of the latter kind have already been foreshadowed and exemplified by the investigations of Gorgeu upon the colors of manganese compounds (Liebig und Kopp's Jahresb. für 1853. 358; Am. Jour. Science, [2], xvi, 416), which explain perfectly the discrepant observations previously made upon these colors, by the interfering colors of impurities. In connection with such investigations a *scale of colors*, founded upon fixed natural standards, if such a thing could be devised, would of course be of great importance. The modifying influences exerted upon the colors of *precipitates* by the presence of other substances precipitated with them is another branch of the subject fully worthy of special investigation, and would probably lead us to new modes for the qualitative detection of certain substances.

I have made attempts to obtain crystallized double chlorids corresponding to the neutral tinted mixtures of chlorid of cobalt with the green and blue chlorids, but have obtained only negative results. The cobalt chlorid crystallizes out separately or at least only mechanically mixed with a little of the other chlorid. It would be very interesting to determine quantitatively the *proportions* of the several other chlorids which produce the neutral tint with that of cobalt.

when any interfering substance is present, as above recommended. If neutral, chlorid of sodium is added, instead of muriatic acid, to avoid dilution. If carbonate of soda has been used to precipitate iron, lead, baryta, etc., it is better to *concentrate* somewhat before acidulating with chlorohydric acid. Indigo solution (which should also be strong) is then added until a feeble blue tint (best perceived by holding the test tube *inclined from* the operator on a piece of white paper) is communicated. The mixture is then warmed, and concentrated oil of vitriol added *cautiously* (to avoid explosive ebullition) with constant agitation. If but traces of nitric acid be present the bleaching may not take place for some minutes, or until a considerable quantity of oil of vitriol has been added. If the oil of vitriol be free from iron and nitric or nitrous acid (which latter two contaminations may be removed by previous boiling with a little oxalic acid, after the method of Löwe), it is not necessary that it should be otherwise pure. After the bleaching point has once been reached, if a fresh portion of indigo solution be added, it will generally be bleached *immediately*. In this way I detect practically and certainly one part of NO^5 (as saltpetre) in 25,000 parts of water. In 50,000 parts the reaction is no longer distinct, and the liquid must be concentrated after addition of excess of carbonate of soda. The function of the sulphuric acid is not merely, as appeared to me at first, to appropriate the water present, and produce a *quasi-concentration*, for chlorid of calcium cannot be successfully substituted for it. It seems probable that in the presence of a large excess of sulphuric acid, Gay-Lussac's NO^2Cl and Cl^2 are formed, instead of NO^2Cl^2 and Cl. When this mode of manipulation is used, the presence of ammoniacal salts does not seem to exert any unfavorable influence.*

* Before leaving the subject I must present some further observations on which I cannot but *hope* to found a method of testing for nitric acid in the presence of iron. I find that metallic iron (*pulvis ferri*) reduces ferric to ferrous oxyd readily even at the ordinary temperature, whilst nitric acid (free from NO^3) unless very concentrated, does not reoxydize the protosalt. In fact it is already well known that in dilute acid solutions containing nitric and no nitrous acid, iron decomposes water just as in dilute sulphuric acid, and ferrous nitrate is formed. If then means could be contrived to obviate wholly the interference of atmospheric oxygen during the operation of *filtration*, it would be very easy, by acidulating the liquid to be tested with chlorohydric acid, adding a little protosulphate of iron and *pulvis ferri* in the cold, filtering, boiling the filtrate (during which last operation ferric salt would be formed from the ferrous, at the expense of the oxygen of the nitric acid) and then testing for sesquioxyd of iron, to detect nitric acid in the minutest quantities. This would also furnish us with a means of separating qualitatively nitric and nitrous acids.

Art. VII.—*Electrical Phenomena in Houses.*

1. *On the Electrical Phenomena observed in certain houses in New York;* by Elias Loomis, Professor of Mathematics and Natural Philosophy in New York University.

Read before the American Association at the Baltimore meeting, May, 1858.

At the meeting of the American Association for the Advancement of Science held at New Haven in August, 1850, I gave an account of some remarkable electrical phenomena observed in certain houses in New York. That account was received at the time with some surprise; but it soon appeared that similar phenomena had been observed in a much larger number of houses than had been supposed, and every one who was at first skeptical about the facts had an opportunity of convincing himself by personal observation. At present I am not aware that there is any person in the United States who doubts the truth of the statements which I made at New Haven in 1850, or who charges them with exaggeration.

The winter of 1856–7 I spent in Berlin, and I mentioned the leading particulars of these phenomena to some of the professors of the Berlin University. They all expressed very great surprise at my statements, and some of them took no pains to conceal their incredulity. In August, 1857, I attended the meeting of the British Association at Dublin, and made a short communication on the same subject to that Association. The facts were considered very remarkable, and I could not learn that anything similar had ever been observed in any part of Europe. I then decided to improve the first opportunity on my return to New York, to verify my former observations, and to procure the concurrent testimony of a second witness to corroborate my statements. The house in which my principal observations in 1850 had been made was the house of Mr. D. W. Catlin, a merchant of New York, who resides in Fourteenth street. Upon my stating the case to Mr. Catlin, he gave me full liberty to make such additional observations and experiments in his house as I might desire.

The past winter has proved unusually mild, and for many weeks it seemed doubtful whether a favorable opportunity would be presented for witnessing these electrical phenomena, as it is only in extremely cold weather that they are at all remarkable. About the middle of February, 1858, the first opportunity presented itself. On the morning of Feb. 11th the external thermometer stood at 12°; on the morning of the 12th it stood at 16°; on the morning of the 13th it stood at 18°. On the evening of the 12th, the thermometer then standing at 24°, I called at Mr.

Catlin's in company with Prof. Samuel St. John, Professor of Chemistry in the College of Physicians and Surgeons of this city. We found the parlors at a temperature of 70°, and the electricity was quite noticeable, although by no means so abundant as at my visit in 1850. We first measured the *length* of the spark by employing two brass balls supported on glass rods in such a manner that the distance between the balls could be regulated at pleasure. The diameter of one ball was $\frac{2}{3}$ inch, that of the other $\frac{9}{10}$ inch. When Mrs. C. walked briskly across the room and touched one of the balls with her finger, the other ball being in communication with the gas-pipe, the spark would not pass from one ball to the other if the distance much exceeded *one quarter* of an inch, yet this spark was quite intense, and was accompanied by a good snap. When I skipped across the room in the same manner, I gave a bright spark, but it would not pass through a distance quite as great as that furnished by Mrs. C.

We next attempted to light the gas from the chandelier by means of the spark. One of the burners was extinguished, and when its temperature had fallen to about blood-heat, Mrs. C. attempted to light the gas by a spark from her finger. Three or four of the first attempts were unsuccessful; perhaps because the gas was not flowing freely at the time; perhaps because the spark passed on one side of the gas-jet. At length Mrs. C. took a pocket-key in her hand, and skipping briskly across the room, gave a spark from the handle of the key which ignited the gas.

We next poured a small quantity of ether into a shallow metallic cup, and attempted to ignite it by a spark from the finger. The first attempts were unsuccessful; generally because the spark was received on the side of the dish, and did not pass through the ether. After a few trials the ether was fired by a spark from Mrs. C.'s finger.

We next received a succession of sparks upon the knob of a Leyden jar, and I received the charge through my body. The shock was sufficient to convulse my arms somewhat unpleasantly.

We next suspended a pith-ball by a silk thread, and having rubbed a stick of sealing-wax upon the carpet, electrified the pith-ball. After skipping across the room, I presented my finger to the pith-ball and found it violently repelled, showing that the electricity of my body was of the same kind as that of the sealing wax, which conforms to the result which I published in 1850. It should be remarked that before commencing the preceding experiments, I exchanged my boots for a pair of dry slippers with thin soles.

On the evening of March 5th, 1858, Prof. St. John and myself made a second visit to the house of Mr. Catlin. The sky was free from clouds, but the stars shone somewhat dimly. The external thermometer stood at +7°. On the morning of the 5th

the thermometer stood at +8°; and on the morning of the 6th at +12°. We found the temperature of Mr. Catlin's parlor 69°, and the electricity was more abundant than at our previous visit. We first measured the length of the spark by means of the same apparatus we employed in our former experiments. The balls were at a distance of one-third of an inch. I again exchanged my boots for a pair of dry slippers, and after skipping briskly across the room and touching one of the balls with my finger, the spark passed to the other ball. I succeeded in passing a spark when the distance of the balls slightly exceeded one-third of an inch, and the spark from Mrs. C.'s finger passed a little farther than my own; but even this would scarcely pass a distance of four-tenths of an inch.

We next attempted to light the gas from a burner which was quite cool. We allowed the gas to flow for a time in order to be sure that the atmospheric air was all expelled. Prof. St. John then held his finger over the opening, and I took in my hand a brass rod terminated with a small ball. I skipped across the room and applied the ball to the burner, but the gas was *not* ignited. The spark evidently passed a little on one side of the gas-jet. A second trial failed, and evidently for the same reason. The third time I presented the ball to the burner with more caution, the spark passed through the gas, and *the gas was ignited.*

We next repeated the experiment with ether in a metallic cup. Prof. St. John held the cup in his hand, and after shuffling across the room, I presented the brass ball to the surface of the ether, but it was not ignited. A second time the experiment also failed; but the third time, after skipping a little more actively across the carpet, I succeeded in firing the ether.

What are the circumstances most favorable to the success of the preceding experiments?

1. A low temperature of the external air. I have never heard that any phenomena of this kind have been observed except during that period of the year when the houses are warmed by fires; and the phenomena are most remarkable during the coldest weather. The electricity is not abundant unless the external temperature is below 32°; and it is most abundant when the thermometer sinks to the neighborhood of zero. I have never heard of a single fact at variance with this statement.

2. A high temperature of the interior of the house, accompanied by considerable dryness of the air. In a cold room even when the external thermometer is at zero, but little electricity can be obtained by friction upon a carpet. A high temperature is needed, and the higher the temperature the better; and in those houses in which the electricity has been most abundant, a high temperature is preserved almost uninterruptedly during the winter season. In all my observations at Mr. Catlin's house, the

thermometer in the parlors stood at about 70°. From all the facts which I have been able to collect, I infer that a furnace placed in the cellar, and sending its heat through flues to the parlors and other portions of the house, is more favorable to electrical excitement than any other mode of heating, whether by means of a stove or an open grate. Perhaps the only reason for this difference is that when a furnace is used, the entire house is more sure to be kept thoroughly warm and dry. On many of the furnaces in New York, perhaps on most of them, a dish of water is placed to supply moisture to the heated air; but it is also true that in all the modern and well-built houses in New York, so far as I have observed or heard, particularly in those which are warmed by furnaces, the doors and wainscot, together with the furniture, during winter habitually shrink and crack, indicating a very dry atmosphere.

3. A thick and substantial woolen carpet. My own observations and information lead me to the following conclusions: that without a carpet the phenomena I have been describing are wholly unknown; that with an ordinary Ingrain carpet, but feeble electricity is obtained; a second carpet or a drugget spread upon the first improves its electrical qualities. A Brussels carpet is much better than an Ingrain; and a heavy velvet carpet is decidedly the best of all. The carpet unquestionably serves as an insulator to preserve the electricity from being dissipated; and I also regard it as performing a still more important function.

4. A dry slipper, with a sole not very thick, appears to be favorable to the success of these experiments. A boot or shoe with a moist sole succeeds but poorly. Ladies are generally more successful in these experiments than gentlemen, chiefly, I think, from the fact that the soles of their shoes are ordinarily thin and dry. In my experiments at Mr. Catlin's house, I gave but a very feeble spark when dressed in boots; but after I had put on a pair of dry slippers, I gave a spark nearly equal to that given by Mrs. Catlin. A shoe with a thin sole is preferable to a boot with a thick sole, partly because the latter is less likely to be thoroughly dry, and therefore not so well adapted to exciting electricity, and also because, even if it were perfectly dry, its great thickness would interfere with the communication of the electricity to the body as fast as it was excited.

What is the source of the electricity observed in the preceding experiments?

In my paper published in 1850, I gave it as my opinion that the electricity was excited by the friction of a leather shoe upon a woolen carpet. I proved by direct experiment that by such friction, electricity was actually excited; and I still believe that this is the principal, if not the only, source of the electricity.

Some have thought that the electricity was due, at least in part, to the dress of the experimenter. I have satisfied myself that electricity may be excited in shuffling across a carpet by any person, no matter what his dress may be, provided only that he have shoes with a dry leather sole. Children of all ages, boys and girls, as well as persons of mature years, excite electricity in the same way. I have never heard of an individual who had tried the experiment in a house similar to that of Mr. Catlin's, without exciting considerable electricity. No particular material or quality of dress is essential to the success of the experiment.

It is a very common impression, and one which is countenanced by my own observations, that a silk dress is favorable to the electrical excitement. A silk dress saves the electricity which is accumulated upon the person from being dissipated as fast as it is excited; but I do not think the silk dress performs any important active part in the electrical excitement. I believe it is true that ladies generally succeed better in these experiments than gentlemen, and ladies generally succeed best when they wear a silk dress; but from the statement of Prof. St. John which accompanies this paper, it appears that small boys in their ordinary woolen dress, may be equally electrical; and I am inclined to think that the uniform success of ladies in these experiments is due to the fact that they are more habitually confined to the house; and their dress, particularly the shoe, is more thoroughly dry.

Some have imagined that a silk wrapper worn next to the skin was important to the success of these experiments; but this is by no means essential, for one of the most electrical cases of which we have any knowledge was that of a boy described in Prof. St. John's communication, whose dress contained not a particle of silk, and who wore cotton next to his skin.

2. *Notice of some Electrical Phenomena witnessed in houses in the cities of New York and Cleveland, Ohio;* by SAMUEL ST. JOHN, Professor of Chemistry in the College of Physicians and Surgeons, New York City.

Read before the American Association, at the Baltimore meeting, May, 1858.

BY invitation of Prof. Loomis of the New York University, I accompanied him on the evening of the 12th of February, 1858, to witness some experiments on electricity, exhibited in a house in Fourteenth street in the city of New York. The rooms in which the experiments were performed had upon the floors thick velvet carpets and the usual furniture of elegant houses; they are warmed by furnaces, and are kept at a nearly uniform

temperature of 70° F. The experiments were performed by the gentleman and lady of the house and Prof. Loomis who had put on dry slippers. After walking rapidly through the parlors with a shuffling motion, very bright electrical sparks were exhibited when the hand was presented to the chandeliers or other good conductors communicating with the ground. Gas was ignited at one of the burners by a spark from a key in the hand of the lady, and sulphuric ether inflamed by the spark passing from her finger to the liquid which I held in a metallic cup in electrical connection with the earth. The spark was made to pass between two small insulated brass balls, with a view to measure its length. The greatest length attained was one-fourth of an inch. The spark exhibited a beautiful appearance in a darkened room, when the fingers were brought near to the wall-paper, dispersing itself through the space of a foot or more over the gilded ornaments of the paper. On the evening of the 5th of March, the coldest day of the season, the experiments were repeated in the same rooms, when a sensible increase of electrical intensity was discerned. The gas and ether were inflamed by Prof. Loomis holding a brass ball in his hand; and the length of the spark attained was a little more than one-third of an inch.

These phenomena were similar to such as I often witnessed during the winters of 1854–5 at the Cleveland Female Seminary, located in the southeast quarter of the city of Cleveland, Ohio. The building is three stories high, of brick, with a sandstone basement, and is warmed by three furnaces supplied with the ordinary bituminous coal of southeastern Ohio, the fires declining but not becoming extinct during the night. The temperature of the rooms varied considerably, sometimes rising above 80° but rarely falling below 60°, even during the night. The rooms in which the electrical manifestations were conspicuous, were the parlors on the first floor above the basement. The floors of these rooms were covered with substantial Brussels carpets. The seasons when they attracted especial attention were periods of severely cold weather—the thermometer on one occasion indicating 23° below zero; the electrical excitement diminished in mild weather, and ceased entirely when it rained. The carpets on the halls and other rooms were thinner fabrics than Brussels carpeting, or composeed partly of cotton or linen, and upon these the electrical phenomena were barely discernible. In the parlors, electricity was manifested during dry cold weather at all hours of the day, but much more strikingly in the evening after the young ladies had spent an hour in recreation and dancing. On such occasions the intensity of the spark was such as readily inflamed ether and pulverized resin, and measured repeatedly one-half inch, passing between insulated balls to the furnace register, which was in good electrical communication

with the earth. All persons remaining in the rooms were enabled to communicate sparks to conductors, but the longest sparks were given by two boys of the ages of nine and eleven years, after running and sliding upon the carpets; this we attributed to the friction evolved by their unconstrained freedom of motion. These boys wore dry slippers, were clad in woolen, one of them wearing flannel next to his person and the other cotton, the latter, who was of more vigorous constitution and active habits, giving the more vivid spark. A difference of electrical accumulation was also discernible among the young ladies, which we were inclined to ascribe to diversities in their dress, silk, woolen, cotton—the silk and woolen appearing more favorable to success. In one instance the different degrees of moisture upon the skin seemed to affect the amount of electricity communicated. These phenomena attracted the attention of all the inmates and visitors of the seminary; many persons expressing surprise and some consternation on receiving a shock as they entered the room and took the hand presented to welcome them preceded by a vivid spark. The passage of the spark over glass by bits of tinfoil disposed in letters and in the 'spiral tube,' together with the usual experiments on electric light, were repeatedly exhibited as a source of amusement.

Art. VIII.—*Mineralogical Notices*; by Prof. George J. Brush, of the Yale Scientific School.

1. *Gieseckite?*

During the summer of 1857, while on a visit to the celebrated mineral locality at Diana, Lewis county, N. Y., my attention was called to a green mineral crystallizing in large hexagonal prisms. In external appearance it resembled apatite, but on analysis it proved to be a silicate. Dr. Geo. N. Hubbard of Natural Bridge has kindly supplied me with a number of these crystals, from which I am able to give the following characters.

The mineral is found in a highly crystalline limestone and is associated with a brown augite and with magnetic pyrites; those crystals which are exposed are coated with a thin layer of black oxyd of manganese, derived from the water of a stream which overflows the locality several months every year. It occurs in stout prisms from a quarter of an inch to two and a half inches in length. The crystals are six-sided, and are terminated by a plane at right angles to the prism; generally, however, the basal edges are replaced by the planes of a pyramid. The corresponding planes in different crystals do not give constant angles, as

will be seen from the following table containing the measurements of several crystals numbered 1 to 6.

No.	Inclination of base on				Prismatic face (*I*) on				*I* on base, over			
	1	1*b*	2	3	1	1*b*	2	3	1	1*b*	2	3
1	135° 30′	137°	135° 10′	135° 20′		133°	135°	134°40′	90°	90° 40′		
2	133° 20′		135°		134°		134° 30′		87°		89° 20′	
3	139°	138°	135° 20′	135° 20′	130°		134° 40′		89°		90°	90°
4	135° 20′		135° 40′		134° 40′		134° 20′		90°		90°	
5	138°	135° 40′			131°				89°	91°		
6	137°		135° 40′				135°				90° 40′	

The planes of the pyramid at one end of the prism are numbered 1, 2, 3, 1*b*, 2*b*, 3*b* in order around; 1*b* being opposite to 1. Crystal No. 3 was terminated at both ends, and while the inclination of the prismatic face *I* on 1 at one end was 130°, (as stated above,) the same *I* on 1 at the other end was 134° 30′. The "prismatic face *I*" referred to in the table is in each case that plane of the prism which is in the same vertical zone with the pyramidal plane mentioned. In Nos. 1, 2, 3, 4 and 6, the angle between the faces of the prism was 120°.

Many of the crystals have a perfect cleavage parallel to the faces of a hexagonal prism, the cleavage being equal and like in lustre in the three directions. In other specimens the cleavage is scarcely perceptible and some show no traces, but break with a waxy fracture. The thin layers from cleavable crystals are not themselves cleavable like those of true crystals, but have generally the compact waxy fracture of the uncleavable crystals. The color varies from light pea-green to leek-green, and the lustre from vitreous to greasy. Thin pieces of the mineral are translucent. Hardness =3—3·5. Specific gravity 2·736—2·75. Before the blowpipe in forceps becomes opaque and fuses to a white enamel; in the glass tube gives alkaline water; with salt of phosphorus gives reactions for silica and iron. Decomposed by acids without gelatinizing. The powdered mineral heated over a blast lamp in a platinum crucible agglomerates to a semi-fused mass which can no longer be decomposed by acids.

As the crystals vary so much in their crystallographic and physical characters I expected to find a like variation in their chemical composition, and in order to test this point three specimens differing considerably in appearance were selected, and a complete analysis was made of each.

Qualitative examination showed the presence of silica, alumina, iron, lime, magnesia, potash, soda, and water, together with a small amount of carbonate of lime, due to mechanical mixture with calcite, the last traces of which it was found difficult to separate from the mineral as selected for analysis.

In the quantitative determinations, the mineral was decomposed by carbonate of soda; the alkalies were determined by Smith's method. In one case the water was determined directly

by heating in a glass tube in a stream of dry air and collecting the moisture in a chlorid of calcium tube, and in the two other analyses the loss by ignition was considered as water after subtracting from it the small amount of carbonic acid which the mineral was found to contain. The following are the results: The material for analyses Nos. 1, 2 and 3 was taken from three crystals differing considerably in external characters: No. 1, uncleavable; No. 2, distinctly cleavable; No. 3, mixed cleavable and uncleavable. Nos. 4 and 5 are two determinations made on No. 3 to ascertain the state of oxydation of the iron.

Sp. gr.,	2·75	2·749	2·736		
	1.	2.	3.	4.	5.
Silica,	45·55	45·75	45·70		
Alumina,	31·62	31·25	31·65		
Sesquioxyd of iron,	——	——	——	27	27
Protoxyd of iron,	0·88	1·05	1·10	72	81
Lime,	2·42	1·96	2·21		
Magnesia,	3·38	3·59	3·46		
Soda,	1·06	0·67	0·90		
Potash,	8·11	8·47	8·06		
Water,	7·32	6·58	7·01		
Carbonate of lime,	0·42	0·56	——		

This uniformity of composition was unexpected, and is quite remarkable. The description given clearly shows that the crystals are pseudomorphs. This appears (1.) from the wide variation in angle; for such variations, while hardly known in real crystals that are apparently so perfect in their faces, do exist in crystals that have undergone pseudomorphic changes. It is apparent (2.) in the diversity as to cleavage—cleavage being seemingly perfect in some crystals and wholly absent in others, and the waxy and cleavage structure being at times mixed in the same specimen. It may be inferred also (3.) from the identity of composition under these diversities; for in real crystals so wide differences would be in some way represented in the constitution. But what the original mineral was which has been here altered is a question more difficult to answer. One fact is clear, from the cleavage observed as well as the form, that the crystallization is *hexagonal* and not trimetric.

In physical as well as chemical characters this substance approaches gieseckite, liebenerite and pinite, all of which have been considered as pseudomorphous minerals. In the recent analyses of gieseckite by v. Hauer he obtained:—

	$\dot{S}i$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{K}$	$\dot{H}$
1.	46·40	26·60	6·30	*tr.*	8·35	4·84	6·76=99·25
2.	45·36	27·77	——	——	7·39	——	6·87

The iron in No. 1 was given as protoxyd, but no direct determination was made to ascertain the state of oxydation. If it be considered as sesquioxyd, and we compare the oxygen ratio with that of the Diana mineral, we have:

	$\dot{R}$	$\ddot{R}$	$\dot{S}i$	$\dot{H}$
Gieseckite,	4·16 :	14·53 :	24·10 :	6·01 = 1 : 3·50 : 5·88 : 1·44
Diana mineral,	4·00 :	14·80 :	23·88 :	6·19 = 1 : 3·70 : 5·97 : 1·55

These ratios are so nearly alike, that the Diana mineral is probably gieseckite in which a portion of the magnesia is replaced by an equivalent amount of lime and potash. The oxygen ratio may also be expressed by $\frac{2}{3}\dot{R} : 2\frac{1}{3}\ddot{R} : 4\ddot{S}i : 1\ddot{H}$, which gives the formula $(\frac{2}{3}\dot{R}^3 + \frac{7}{3}\ddot{R})^3\ddot{S}i^4 + 3\ddot{H}$, or more simply $(\dot{R}^3, \ddot{A}l, \ddot{H}^3)\ddot{S}i$.

The researches of von Hauer and Kenngott show that gieseckite and liebenerite are closely related to each other. They are both hexagonal and both have many of the physical properties of the Diana mineral. They all have nearly the same composition as the pinite from Auvergne and from Saxony as given by Rammelsberg and Marignac.

Pinite is stated to be hexagonal by the earlier mineralogical writers, but Haidinger* has referred it to the trimetric system, and classes it as an altered iolite. Phillips, however, gives a figure of pinite from Puy de Dome with measurements which seem to prove it to be hexagonal. Marignac also favors the idea that it is hexagonal. But, whatever the fact about pinite, the form of liebenerite and gieseckite, like that of the Diana mineral, is unmistakably hexagonal.

The close relation of these minerals in chemical composition is seen from the following analyses.

	$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$	$\dot{H}$	
1. Liebenerite,	45·13	36·50	2·63	—	—	0·81	0·75	8·07	0·42	4·70	Oellacher.
2. "	44·47	36·56	1·77	—	—	—	1·33	9·89	0·92	5·06	Marignac.
3. "	44·45	38·75	2·26	—	—	1·58	*tr.*	6·45	2·79	4·75	v. Hauer.
4. Gieseckite, Greenland,	46·40	26·60	—	6·30	*tr.*	—	8·35	4·84	—	6·76	"
4*a*. " "	46·40	26·60	7·00	—	*tr.*	—	8·35	4·84	—	6·76	"
5. " Diana,	45·66	31·53	0·27	0·77	—	2·20	3·48	8·21	0·88	6·97	Brush.
6. Pinite, Auvergne,	47·50	31·80	—	3·92	—	—	1·78	9·05	0·92	5·03	Marignac.
7. " St. Pardoux,	48·92	32·29	3·49	—	0·11	0·51	1·30	9·14	—	4·27	Rammelsb.
8. " Mont Brévent,	44·70	31·64	—	6·57	—	—	2·86	7·89	0·95	5·39	Marignac.
9. " Aue,	46·83	27·65	—	7·84	—	0·49	1·02	6·52	0·40	7·80	Rammelsb.
10. " Penig,	47·00	28·36	—	7·08	—	0·79	2·48	10·74	1·07	3·33	"
11. " Penig,	48·00	28·00	—	9·66	—	0·75	—	11·35	—	3·00	Scott.
12. " Saxony,	46·10	32·46	—	4·27	—	—	2·26	9·00	0·46	5·45	Marignac.

1 and 2 as quoted by Kenngott in Sitzungsberichte Wien Akad., ix, 597.
3. v. Hauer, Jahrbuch k. k. geologische Reichsanstalt, 1853, 147.
4. " " " " " 1854, 76.
4*a*. " same analysis, with iron calculated as $\ddot{F}e$.
5. mean of three analyses.
6, 8 and 12, Marignac, Bibliothèque Universelle de Genève, 1847, 159.
7. Rammelsberg Mineralogie, Suppl. iv, 178.
9 and 10. " " Suppl. iii, 94.
11. " " ii, 60.

This similarity in chemical composition would seem to indicate a common origin for these pseudomorphous minerals. Tamnau† endeavors to show that the Greenland gieseckite is altered nepheline, but he does not support his opinion by analyses. Blum‡ and Bischof§ consider both gieseckite and liebenerite to be altered nepheline, although the relation to nepheline is not clearly shown; while Kenngott‖ suggests that they may have

* Pogg. Ann. lxvii, 454. † Pogg. Ann. xliii, 149. ‡ Nachtrag, ii, 131.
§ Lehrbuch der chemischen und physicalischen Geologie, ii, 2259.
‖ Sitzungsberichte Wien Akad., ix, 604.

been derived from some unknown mineral. We are not in possession of facts which warrant a positive decision. Some of the Diana crystals certainly have the lustre, color, and general aspect of elæolite.

It is noteworthy that in northern New York and in Canada there is a class of rocks represented by parophite and dysyntribite which are hydrous silicates of alumina and potash. Moreover, the potash agalmatolites approach these in chemical composition,* as will be seen from the following analyses. The dysyntribite in fact occurs at Diana, and may have had a similar origin with the crystals here described. But I would not assert that the same potash-silicate may not tend to form from the alteration of different silicates.

		Si	Al	Fe	Fe	Mn	Ca	Mg	K	Na	H	
1.		48·50	27·60		5·67	—	1·30	2·24	5·30	1·91	7·00	T. S. Hunt.
2. Schistose parophite,		48·42	27·60		4·50	—	2·80	1·80	5·02	2·78	6·88	"
3.		48·10	28·70		4·80	—	2·10	1·41	4·49	1 53	8·40	"
4. Dysyntribite,		46·65	31·23	3·69	—	*tr.*	*tr.*	0·50	11·68	*tr.*	5·03	Smith & Brush.
5.	"	44·78	35·39	2·76	—	0·30	0·59	0·48	6·87	3·60	5·05	"
6.	"	44·94	25·05	3·33	—	*tr.*	8·44	6·86	5·80	*tr.*	6·11	"
7.	"	44·42	20·81	4·15	—	*tr.*	12·62	8·52	3·82	*tr.*	5·58	"
8. Agalmatolite, China,		49·82	29·60	—	1·50	—	6·00	—	6·80	—	5·50	Thomson.
9.	" Schemnitz,	49·50	27·45	—	1·03	*tr.*	5·56	0·72	10·20		5·10	Karafiat.

1, 2, 3, Hunt, abstract from Geol. Rep. Canada for 1852, 95, in this Journal, [2], xvii, 127. 4, 5, 6, 7, analyses of different specimens of dysyntribite showing it to be a rock and not a simple mineral, this Journal, [2], xvi, 50. Its relations to pinite are shown in this paper. 8, Thomson's Mineralogy, i, 343. 9, Pogg. Ann., lxxviii, 575.

2. *Compact Pyrophyllite.*

In a recent examination which I have made of some varieties of Chinese figure-stone (agalmatolite), one specimen analyzed proved to be identical in chemical composition with pyrophyllite, and on reference to Dana's Mineralogy, p. 253, was found an analysis of Chinese agalmatolite by Walmstedt, which gave a similar result. This led me to consult the Oefversigt af Kongl. Vetenskaps-Akademiens Förhandlingar for 1848, p. 111, in which three analyses by Walmstedt are given. His results are communicated by Svanberg in a note to Sjoegrens analyses of Swedish pyrophyllite.

It is somewhat remarkable that Svanberg's note seems to have been entirely overlooked by mineralogists, for in it he calls attention to the fact that this agalmatolite is identical with the Swedish pyrophyllite, as also with that from Spaa analyzed by Rammelsberg.

* Prof. T. Sterry Hunt, of Montreal, has called my attention to the near relation between the composition of the Diana gieseckite and his analyses of the minerals algerite (this Journal, [2], viii, 105) and wilsonite (ib., xix, 428),

	Si	Al	Fe	Mg	K	Na	Ca	H
Algerite,	52·28	26·08	1·93	1·20	10·69	—	—	7·92
Wilsonite,	47·70	31·22	—	4·14	9·38	0·95	0·39	5·35

The facts seem to sustain the suggestion above, that the same potash-silicate may result from the alteration of different mineral species. This is an important subject for further investigation.

The specimens that I have examined were brought from China by Dr. M. C. White of New Haven. Dr. White informs me that the Chinese obtain this "figure-stone" from the mountains, about twenty English miles from Fuhchau.

The mineral has a white to greenish-white color and is translucent; it is perfectly compact, sometimes veined like marble, the color of the veins being dark red and due to the presence of sesquioxyd of iron. B.B. infusible, or fusible only on the thinnest edges; moistened with nitrate of cobalt gives the reaction for alumina; not decomposed by acids. Hardness 3. Specific gravity 2·81. Analysis showed it to be a hydrous silicate of alumina with traces of iron, lime, magnesia, and alkalies. Of the following Nos. 1, 2 and 3 are the original analyses by Walmstedt, and No. 4 is my analysis.

	Si	Al	Fe	Ca	Mg	Sn	K, Na	H
1.	65·96	28·58	0·09	0·18	0·15	—	—	5·16
2.	66·38	27·95	0·06	0·18	0·06	—	—	5·20
3.	65·65	28·79	0·28	0·23	*tr.*	*tr.*	—	5·11
4.	65·95	28·97		0·22	—	—	0·25	5·48

Their close correspondence with pyrophyllite may be seen by comparing them with the following analyses of that species:

	Si	Al	Fe	Ca	Mg	Mn	H	
Pyrophyllite from Spaa,	66·14	25·87	—	0·39	1·49	—	5.59	Rammelsberg.*
Westana,	67·77	25·17	0·82	0·66	0·26	0·50	5·82	Sjoegren.†
Sp. gr.=2·78,	65·61	26·09	0·70	0·69	0·09	0·09	7·08	
Chesterfield District, N. Car.,	64·82	28·48	0·96	0·55	0·33	—	5·25	Genth.‡
	66·01	28·52	0·87	0·23	0·18	—	5·22	

This so-called agalmatolite may therefore be considered as a compact pyrophyllite. The formula $\dot{Al}^2\ddot{Si}^5+2\dot{H}$=Si 65·66, Al 29·22, H 5·12, represents very well the composition of both varieties.

It is true that the compact mineral does not swell up and spread into fan-like shapes as is the case with the foliated variety, but this is simply due to a difference in structure; the same circumstance explains the difference in fusibility. The compact pyrophyllite seems to bear the same relation to the foliated variety, as steatite bears to foliated talc.

The formulæ of talc and pyrophyllite are as follows:

Talc, $(\dot{Mg}^3)^2\ddot{Si}^5+2\dot{H}$,

Pyrophyllite, $\dot{Al}^2\ddot{Si}^5+2\dot{H}$.

It is hence obvious that the two are analogous in chemical composition.

3. *Unionite.*

In this Journal, [2], xv, 211, Prof. J. Lawrence Smith and myself published analyses of a mineral which we supposed to

* Pogg. Ann., lxviii, 513.

† Oefv. K. V. Ak. Förh., 1848, 110.

‡ This Journal, [2], xviii, 410.

be the unionite of Silliman. We had no reason to doubt the authenticity of our specimens, as they were collected at the unionite locality by Mr. L. White Williams, and were received by us from Prof. B. Silliman, Jr. A careful examination, however, of the original specimen in Prof. Silliman, Jr.'s cabinet, showed such a difference in the physical characters that I have been induced to make an analysis of the original specimen from material kindly furnished me by Prof. Silliman, Jr.

Its physical characters correspond perfectly with those given by Silliman. B.B. fuses easily, with intumescence, and glows with a white light. In the tube yields water. Sp. gr.=3·299. After ignition it gelatinizes with hydrochloric acid. Analysis of 1·036 grams fused with carbonate of soda gave:—

		Oxygen.	
Silica,	40·61	21·10	3
Alumina,	33·44	15·63	2
Sesquioxyd of iron,	0·49	15	
Lime,	24·13	6·86	1
Magnesia,	*tr.*		
Ignition,	2·22		

The oxygen ratio is that of epidote, and the analysis agrees with Rammelsberg's analyses* of zoisite. Its physical characters are also identical with zoisite, and it forms one of the purest varieties of lime-epidote.

4. *Feldspars from the Danburite locality.*

Prof. J. Lawrence Smith and myself have shown† that danburite is associated with both orthoclase and oligoclase. This locality has been re-opened during the past year, and the feldspar now obtained there is chiefly orthoclase. It forms a vein in dolomite from one and a half to two feet in width, and occurs in broad cleavable masses as well as in the more compact granular form before observed and analyzed by Smith and myself.

The cleavable variety has recently been analyzed by Mr. Geo. F. Barker of the Yale Scientific School, with the following result:

	Si	Al	Ca	K	Na	Ign.
Sp. gr. 2·58.	64·25	18·80	1·20	12·44	2·40	0·30=99·39

The specimens of danburite which were taken from the locality some years since, and from a part of the vein only about two hundred feet distant from the present opening, were not unfrequently found imbedded in oligoclase.‡ This feldspar may be easily distinguished by the fine parallel striæ in one direction (indicative of a triclinic form) observable on its cleavage surface; these striæ are entirely wanting in the other feldspar. It appears therefore that in the same vein, danburite is sometimes imbedded in a potash feldspar and in other cases in a soda-lime feldspar.

Yale Analytical Laboratory, March, 1858.

* Pogg. Ann., c, 133.

† This Journal, [2], xvi, 44.

‡ For analyses, see loc. cit.

ART. IX.—*Fish-rod Balance and Spheroidal Evaporation;* by J. L. RIDDELL, Prof. Chem. in the Med. Dep. of the University of Louisiana.

MESSRS. EDITORS:

I HAVE read an article in your number for January, 1858, p. 39, by Prof. Alfred McMayer, on "the estimation of the weights of very small portions of matter." That he independently invented the instrument therein described, I have no reason to entertain doubt. In 1840, while residing at the U. S. Branch mint of this city, I invented, constructed and used a similar contrivance. I called it the fish-rod balance. I formed a minute tapering hollow tube of glass, mounted it adjustable in a glazed case to avoid drafts of wind, suspended from the small and free end an extremely light pan by a thread of glass, terminating in an indicator point, the point traversing over a micrometer scale, a view of which was commanded by a microscope. Values were written upon the scale from observation, at intervals, and carried out by interpolations. I operated more or less with this instrument for six years, during which time it was inspected by hundreds of persons now living. Prof. McMayer under-estimates its delicacy and over-estimates its reliability.

The purpose to which I mostly applied it, was to determine the amount of non-volatile matter in liquids. Thus: a pipette, marked so as to contain a measure, the equivalent of one gram of water, containing the liquid to be evaporated, was held inclined over a clean silver or platinum capsule, heated by a spirit lamp. The liquid, dropped gradually in, assumed the spheroidal form, and was evaporated, but not quite to dryness, lest the residue should be dissipated by explosion. At the proper moment it was skillfully tossed into a clean porcelain capsule, and presented the earthy and saline residue in the form of a minute sphere, generally too minute to be weighed in an assay balance. The fish-rod balance was then resorted to.

But I found the fish-rod balance to vary materially in its indications of weight, from the effects of varying temperature, from molecular changes in the glass becoming manifest in time, and probably from other causes which I did not investigate. Hence I came to think little of it as an accurate means of determining minute weights, and much of it as a probable means of investigating the obscure laws of molecular changes, a vein of inquiry which as yet I have failed to pursue.

New Orleans, April 17, 1858.

Art. X.—*Contributions to the Palæontological Synchronism of the Coal Measures of Ohio and Illinois*; by R. P. Stevens, M.D.

Is there a stratigraphical synchronism in the two great American coal fields—the Appalachian, and that of the basin drained by the Mississippi river?

I propose to make a contribution of such facts and observations as have fallen under my notice, to assist in the solution of this interesting problem in American geology.

To bring the subject more immediately under the eye, two sections are given. One is of the coal strata of Ohio, as made out by examinations along the line of the Ashtabula and New Lisbon railroad by Dr. J. S. Newberry, and along the Cleveland-and-Pittsburgh and Cleveland-and-Zanesville railroad by myself. The section is carried up to the blue, drab and purple shales and red sandstone which lie between the lower and upper coal-bearing strata of the Appalachian system. The other is taken from the shafts, borings and bluffs at Lasalle, Ill. This portion of the Illinois coal field is selected as offering the best developed system of stratification which is to be found on its northern aspect.

The bare inspection of the two sections will at once satisfy most minds that the solution of the problem cannot be looked for from stratigraphical geology. Indeed, to my own mind, the more numerous the sections, from widely separated localities, the more doubtful the synchronism.

Section.

Ohio.	Feet thick.
Non-productive shales.	
Red sandstone.	
Shales.	
Coal,	1
Clay,	2
Shale,	100
Upper encrinal limestone,	10
Sandstone, fossiliferous.	
Shale.	
Blackband ore.	
Coal,	3
Clay, Trigonocarpon,	5
Sandstone (Mahoning?)	50
Shale,	5
Coal,	6
Clay, "Big Vein,"	5
Sandstone, non-fossiliferous,	20
Coal,	5

Illinois.	Feet thick.
Grey and drab shales,	28
Argillaceous limestone (upper fossiliferous),	5
Coal,	1
Clay,	5
Crinoidal red shale,	20
Limestone, fossiliferous	15
Grey shale, "	5
Blue limestone,	5
Black shale,	17
Blue shale,	10
Limestone,	3
Blue shale, fossiliferous,	18
Grey limestone, "	2
Blue shale, "	9
Limestone, "	2
Blue and black shales,	16
Marble limestone, fossiliferous,	4

Ohio.	Feet thick.
Sandstone,	30
Shale and nodular iron ore (vegetable fossils),	30
Coal (cannel),	30
Shale,	20
Limestone, fossiliferous,	3
Shale, blackband,	
Ore, thin coal and limestone,	20
Shale,	15
Sandstone, vegetable fossils,	40
Blue shale, vegetable fossils,	30
Coal,	3
Shale,	50
Conglomerate (marine fossils in Pa.),	100
Total,	600

Illinois.	Feet thick.
Brown and red shales,	18
Sandstone,	18
Siliceous shales,	36
Coal, } Clay, }	4½ 6
Sandstone,	20
Bituminous shale,	27
Coal, } Clay, }	6 5
Limestone,	11
Greyish sandy shale, often sandstone,	66
Coal, } Clay, }	4 2
Shale,	5
Basal sandstone,	40
Total,	400

I begin my observations with the basal sandstone known as the coal conglomerate, formation No. XII of Prof. Rogers. This rock in McKean Co., Pa., and Alleghany and Cattaraugus Cos., N. Y., contains, besides others, the following species of marine fossils, viz., Orthoceras 3 species, Murchisonia 2 species, Pleurotomaria 1 species, Myalina 1 do., Avicula 1 do., Lyonsia 3 do., and Orthis 1 do.

In Ohio, according to Dr. Newberry, instead of marine fauna it abounds in Calamites, Lepidodendra, and Trigonocarpa. In Indiana, Calamites (Lyell). Illinois, on the Wabash, Illinois and Big Muddy rivers, Calamites and Lepidodendra are abundant. All specimens seen are fragmentary and water-worn.

The arenaceous character of the matrix, as well as the water-worn character of the specimens, forbid their close examination and identification of species; but their general characteristics, gathered as they are from so wide localities, forbids their separation from each other.

So far as the floral testimony extends, the basal sandstones of the northwest portion of the Appalachian and northern of the Illinois are identical.

The roof shale of the first bed of coal, in the ascending series, both in Ohio and Illinois, is very rich in its flora. Nothing can exceed the beauty, richness and variety of the fretted roof of this vein, as seen in the mines at Cuyahoga Falls and Chippewa, Ohio, or at Morriss, Ill.

To Dr. Newberry we are indebted for the development and description of the new and collating of the old genera and spe-

cies of this shale. From the mines of Mahoning and Summit Co., Ohio, even from limited examinations, he has enumerated 41 genera with 150 species. Of these, the following are characteristic of this shale. The beautiful *Whittleseyea elegans*, *Sphenopteris Lesquereuxii*, *S. Kirtlandii*, *S. simplex*, *S. parviflora*, *S. uncinata*, *Alethopteris grandiflora*, *Neuropteris lancifera*. The *Alethopteris Lonchitidis* and *Pecopteris plumosa* he considers identical with *European* species.

The equivalent shale in Indiana and Illinois, over seam of coal No. 1, on the Wabash and at Morriss, Ill., is also exceedingly rich in its flora.

As in Ohio and also in Illinois, the lower beds of the series are the most exuberantly stored with the relicts of the Carboniferous flora. This grand generalization is more significant than the identification of individual species. For it has been shown that in Ohio each mine of this lower vein of coal has species peculiar to itself: the *Whittleseya elegans* being found at Chippewa and not at Mahoning, while the *Antholites priscus* is found at the latter and not the former. If this be so over a limited geographical area, much more may we look for it from strata widely separated, as Ohio and Illinois. There is, however, an identification of two species of Lepidodendra, *undet.*: the one having long nearly equally acuminate areolæ, at the upper and lower angles; the length being one and a half inches, the breadth being only seven-tenths of an inch: the other species much smaller, of diamond-shaped areolæ, the length being two-tenths of an inch. These are found at Chippewa in Ohio, Pine Creek, Ind., and Morriss, Ill.

According to T. A. Conrad, Esq., the iron-stone layers of Coalbrook, England, and of Tioga Co., Pa., have *Productus scabriculus* as a characteristic fossil. The same fossil is found in similar positions, in McKean Co., Pa., Mahoning Co., Ohio, and in equivalent strata, though the iron is scarcely recognized on the Upper Wabash, Ind., and Illinois river, Ill. In the latter state, there is this difference in the distribution of the fossil. It is found in the mountain limestone and ranges upwards through the coal measures, it being found at Paris, Ill., in this rock (N. and P.), in the middle of the series at Danville, Ill., 40 miles north, and again in the upper shales and limestones at LaSalle, 150 northwest.

The thick-bedded sandstone, sometimes becoming very coarse, and even a conglomerate and sandy shales, intervening between coal No. 1 and No. 2 of both sections, is highly floraliferous in the Mississippi and Appalachian systems. I am not aware of the description or identification of any specimens. The fragmentary and crushed conditions in which they are

generally found would forbid it. Sigillariæ and Stigmariæ are common.*

In the limestone No. 1 of the Ohio section, over the second bed of coal, in the state of Ohio, the *Chonetes mesoloba* and *Productus Wabashensis* are first seen. The following are the localities. Mahoning Co. (Newberry), Tuscarawas Co., Coshocton Co., Columbiana and Jefferson Co., O. They range through some two or three hundred feet of the middle coal measures. At the mouth of Big Yellow Creek they are seen in the upper limestone above all the coal strata. These fossils are found in a limestone between the third and fourth seams of coal at Danville, Ill., and range through the entire series of the Vermillion Co. coal. At LaSalle they are seen in the marble limestone, again at Peru, and range upwards through the series. At Centralia the *C. mesoloba* is seen in the upper shales of the coal measures. In Indiana (New Harmony, N. and P.) they occur in the middle of the series.

The limestones and calcareous shales and clays of both States are highly prolific in marine exuviæ. Dr. Newberry says he found in the limestone over the third bed of coal of Mahoning Co. the following genera, viz., Spirifer, Terebratula, Pleurotomaria, Goniatites, Bellerophon, Loxonema, Productus, Macrocheilus, and adds, "nearly all the genera of Carboniferous fossils." On Yellow Creek, O., the number of genera increases in any given strata as we progress upwards to the limestone which lie between the upper and lower coal series of the Appalachian system; while in the western part of Ohio the genera are about equally numerous throughout the whole series. This may be explained by the well known fact of the greater number and thickness of the calcareous strata of the western part of these coal-fields.

In the Carboniferous strata of both States, the following species have been identified, viz., *Spirifer Kentuckensis*, *S. Forbeseyi*, *S. cameratus*, *S. lineatus*, *Terebratula subtilita*, *T. elongata*, *Terebratulina pentatoma*, *Rhynconella*, spec. undet., *Nucula Hameri*, *Cardiomorpha*, spec. undet., *Cyathophyllum Fungites*, *Cyathaxonia*, spec. undet., *Macrocheilus acutus*, *M. inhabilis*, *Bellero-*

* On the north and northwestern edge of the Appalachian coal-fields this sandstone is often a conglomerate and is liable to be mistaken for formation No. XII, or the true basal coal conglomerate. Thus mistaking it, some geologists have fallen into an error, as I think, in placing a bed of coal beneath the *true* Carboniferous conglomerate. Sections in lately published reports of the McKean Co., Pa., beds of coals give a coal bed thus placed. The distinction which I draw, viz., of the lower conglomerate containing marine animal fossils, while the upper never does, is sufficient at all times to distinguish the two. Moreover, the upper conglomerate usually exhibits fragments of carbon comminuted and rounded, while in the lower all traces of carbon are wanting. And again, the lower conglomerate, in the lower portions, contain fragments of Devonian rocks, or in Illinois, even of Silurian, while the upper is composed of purely siliceous and Carboniferous materials.

phon Urii, *B. percarinatus*, *B. costatus*, *Pleurotomaria carbonaria*, *P. virgillati*, *P. sphærulata*, *Euomphalus carbonarius*, *Loxonema Hallii*, *Avicula orbicula*, n. s., two species of *Orthoceras*, undet., *Productus splendens*, *P. Rogersii*, *P. Verneuilianus*, *P. semireticulatus*, *P. clavus?* *P. muricatus*, *Natica ventricosa*, *Nautilus Kentuckensis*, *N. globatus*, *N. striatus*, *Temnocheilus*, two species undet., *Goniatites crenistria.*

Of these species, the following have a great vertical range, viz., *P. Wabashensis*, *P. splendens*, *P. Rogersii*, *P. semireticulatus*, *P. punctatus*, *P. Verneuilianus*, *Chonetes mesoloba*, *Orthis crenistria*, *Loxonema Hallii*, *Euomphalus carbonarius*, *Pleurotomaria virgillati*, *P. sphærulata*, *P. carbonaria*, *Bellerophon Urii*, *B. percarinatus*, *Macrocheilus acutus*, *M. inhabilis*, and *Spirifer cameratus.*

The following species appear to be confined to the upper members, viz., *Spirifer Kentuckensis*, *Rhynconella*, species? *Spirifer lineatus*, *Cyathophyllum fungites*, *Avicula orbicula*, *Terebratulina pentatoma*, and *Terebratula subtilita.*

Table of Carboniferous fossils identified in the Eastern and Western Coal-fields, with Localities and Strata.

Species.	Eastern system.		Western system.	
	Locality.	Strata.	Locality.	Strata.
Spirifer cameratus, Hall,	Pittsburgh, Pa.,	Calcareous shales above the lower coal series.	Vance, Ill.,	Brecciated limestone, middle of the series.
	Coshocton, O.,	2nd limestone.	Salina, Ill.,	Upper limestone.
	Tuscarawas, O.,	" "	LaSalle, Ill.,	" "
	Greentown, O., Hall,	Lower limestone?	Pecos Villages, N. Mexico, Hall,	Coal measures.
			San Sabo Valley, Roemer, Texas,	" "
S. lineatus,	McKean Co., Pa.,	Cherty limestone middle series,	Vance, Ill.,	Brec'd limestone.
	Yellow Creek, O.,	Upper limestone.	LaSalle, Ill.,	Middle limestone.
			Pecos Villages, Hall.	Coal measures.
S. Forbeseyii,	Coshocton, O.,	1st limestone.	Burlington, Iowa,	Mt. limestone, Norwood and Pratten.
S. Kentuckensis,	"	2nd "	Springfield, Ill.,	Upper shales.
			LaSalle, Ill.,	" "
			Weston, Missouri,	Coal measu's, Hall.
			Pecos Villages, N. M.,	" " "
Rhynconella, spec.?	"	" "	LaSalle, Ill.,	Upper shales.
	Summit, Columbiana Co., O.,	Calcareous shales above the lower coals.	Danville, Ill.	Roof of cool, mid. of the series.
Terebratula subtilita,	Yellow Creek, O.,	Upper limestone.	LaSalle, Ill.,	Upper limestone.
	Coshocton, O.,	3d limestone.	Salina, Ill.,	" "
T. elongata,	Pittsburgh, Pa.,	Calcareous shales.	LaSalle, Ill.,	" "
Terebratulina pentatoma,	Summit, Col. Co., O.	" "	" "	" "
Athyris, spec.?	Yellow Creek, O.,	Hydraulic l. stone.	" "	" "
Nucula Hammeri,	Ohio river at mouth of Yellow Creek,	Upper limestone.	Danville, Ill.,	Roof of coal.
	Yellow Creek, O.,	" "	Rush Cr., Ind.,	Coal shales, J. H. McChesney.
	Summit, Col. Co., O.	Calcareous shales.	LaSalle, Ill.,	Black shales.
Cardiomorpha, spec.?	Pittsburgh, Pa.,	" "	Springfield, Ill.,	Upper "
	"	" "	" "	" "
	Yellow Creek, O.,	Upper limestone.	Danville, Ill.,	Roof of coal.
Avicula orbicula, n. s.,	Summit, Col. Co., O.	Calcareous shales.	Springfield, Ill.,	Bl'k upper shales.
Orthis crenistria,	"	" "	" "	" " "
Cyathophyllum fungites,	Yellow Creek, O.,	Hydraulic l. stone.	Danville, "	Roof of coal.
	Pittsburgh, Pa.,	Calcareous shales.	" "	Middle shales.
	Yellow Creek, O.,	Upper limestone.	LaSalle, "	" "
Cyathaxonia, spec.?	Pittsburgh, Pa.,	Calcareous shales.	Centralia, "	Upper "
			" "	" "

Species.	Eastern system.		Western system.	
	Locality.	Strata.	Locality.	Strata.
			Lasalle, Ill.,	Upper shales.
			Danville, Ill.,	Middle shales,
Macrocheilus acutus and M. inhabilis,	Pittsburgh, Pa.,	Calcareous shales.	" "	Roof of coal.
	" "	" "	Springfield, Ill.,	Blk upper shales.
Bellerophon Urii,	Pittsburgh, Pa.,	Calcareous shales.	" "	" " "
B. percarinatus,	McKean Co., Pa.,	Cherty limestone.	LaSalle, "	Middle shales.
	Yellow Creek, O.,	Upper limestone.	Galatea, "	Coal meas., N. & P.
	Summit, Col. Co., O.	Calcareous shales.	Grayville, "	" " "
	Coshocton, O.,	2nd limestone.	N. Harmony, Ind.,	" " "
	Tuscarawas, O.,	" "	Rush Cr., "	" " "
B. costatus,	Pittsburgh, Pa.,	Calcareous shales.	LaSalle, Ill.,	Upper shales.
Pleurotomaria carbonaria,	"	" "	" "	" "
	Summit, Col. Co., O.	" "	Danville, Ill.,	Roof of coal.
P. sphærulata and virgillati,	"	" "	" "	" "
	Pittsburgh, Pa.,	" "	LaSalle, "	Upper shales.
			Rush Cr., Ind.,	Coal shales, J. H. McC.
Loxonema Hallii,	"	Calcareous shales.	" " "	" " "
			Danville, Ill.,	Roof of coal.
Chonetes mesoloba,	Mahoning Co., O.,	1st limestone.	" "	" "
	Coshocton, O.,	2nd "	LaSalle, "	Upper shales.
	Yellow Creek, O.,	Upper limestone.	Centralia, "	" "
Productus scabriculus,	Tioga, Pa.,	Iron-stone shales.	LaSalle, "	" "
	McKean, Pa.,	" " "	Danville, "	Roof of coal.
	Mahoning Co., O.,	" " "	Pine Creek, Ind.,	Lower shales.
P. splendens,	Yellow Creek, O.,	Upper limestone.	LaSalle, Ill.,	Upper limestone.
	Coshocton, O.,	2nd "	" "	Marble limestone.
P. Wabashensis,	Tuscarawas, O.,	" "	" "	" "
	Yellow Creek, O.,	Hyd. limestone.	Danville, Ill.,	Limestone below coal.
P. Rogersii,	" "	" "	N. Harmony, Ind.,	Coal meas., N. & P.
			Danville, Ill.,	Roof of coal.
			Salina, "	Upper limestone.
			Sugar Cr., Ill.,	" " J.H.McC.
			Huntsville, Mo.,	Coal measures. P.
			Pecos Vill., N. M.,	" " Hall.
P. Verneuilianus,	Pittsburgh, Pa.,	Calcareous shales.	Danville, Ill.,	Roof of coal.
	Coshocton, O.,	3d limestone.	LaSalle, "	Upper shales.
	Yellow Creek, O.,	Upper limestone.		
P. semireticulatus,	Coshocton, O.,	1st & 2d limestone.	Warsaw, "	Mt. limestone, N. & P.
			Pecos Vill., N. M.,	Coal measures, H.
P. clavus,	Yellow Creek, O.,	Upper limestone.	Graysville, Ill.,	Upper coal measures, N. & P.
P. muricatus,	Coshocton, O.,	" "	Pike Co., Ill.,	Calcareous clays "
	"		Richmond, Mo.,	" " "
P. equicostatus,	Yellow Creek, O.,	1st & 2d limestone.	LaSalle, Ill.,	Middle shales.
Natica ventricosa,		Upper limestone.	Danville, Ill.,	Roof of coal.
			Vance, "	Brec'd limestone.
Nautilus Kentuckensis,	"	" "	Danville, "	Roof of coal.
N. globatus,	Pittsburgh, Pa.,	Calcareous shales.	" "	" "
N. striatus,		" "	" "	" "
Temnocheilus, spec.?	Yellow Creek, O.,	Middle shales.	" "	" "
Goniatites crenistria,	Summit, Col. Co., O.	Calcareous shales.	" "	" "

APPENDIX.—Since preparing this article for the press, I have been favored, through the politeness of one of the editors of this Journal, with the perusal of M. Lesquereux's highly interesting report on the fossil flora of western Kentucky, in vol. iii of the Kentucky Geological Survey. Through Dr. J. S. Newberry of Cleveland, Ohio, I had previously received the main features of his theory of the formation of coal. I am very free to say, that all my explorations in the field, confirm more and more strongly this theory.

But while assent is freely yielded to the opinion, that coal beds are but the transformed peat-bogs of the Carboniferous continent, and that the beds were cotemporaneous, I cannot agree with him that they were continuous, or even in many instances

contiguous; and that the wide belts of upheaved Devonian and Silurian rocks now separating our coal-fields, were once covered with the carboniferous strata, and subsequently to the coal era, have been denuded by erosion and their debris gone to form the quarternary deposits of the Ohio and Mississippi rivers. It is true, as he well observes, that "the loam deposited by these rivers is sometimes mixed with broken and rolled pieces of coal; there are even some deposits of alluvial rolled coal, or pebbles of coal, heaped in strata in such a way that they have been taken by inexperienced observers, for true coal beds." These I would explain by far more local and circumscribed abrasions, during the drift era. Near the village of Liverpool, Ohio, similar phenomena are to be seen. These were most evidently caused, by the erosion of the valley of the Beaver River, which cuts through the entire coal strata northwards to the valley of Lake Erie, forming a deep and wide channel, through which flowed a boreal current long after the elevated plateau of the coal-fields was dry land. Through this channel and similar ones, came the gravel deposits of the Ohio bottoms,—gravel composed of all the formations from the primitive to the coal inclusive, in which is found "*drift coal.*" The marshes of Cayuga Lake and Lake Erie, and the swamps of the Atlantic shores, and the everglades of Florida are cotemporaneous, but not contiguous. Why may there not have been a similar state of things on our continent during the carboniferous era?

If I rightly apprehend M. Lesquereux, the dynamics of his theory demand an equal subsidence of the continent through all its extent, after each successive growth of peat plants, in order that the marine fauna of shallow or deep water, as the case may be, shall be found in the roof shales and other intermediate and coeval strata. I would explain the diversity of the fauna and flora, as well as the want of synchronism of the coal beds, and associated coal measures of each minor and subsidiary coal basin, by an unequal action of the forces causing subsidence, and consequently a deeper depression of some local basins than others co-equal. Hence, in some roof shales we find molluscs, peculiar to shallow and brackish waters: while in others, where stratigraphically the coal beds are of the same age, we find the relics of deep sea molluscs; and instead of calcareous shales thinly bedded, we find thick strata of limestone, richly stored with corals, crinoids, acephala and conchifera, which are evidently the exuviæ of the dwellers of deep and warm sea waters. Again, I would call in to aid in explaining the various phenomena, the different currents which may have impinged upon our coasts, or swept through the Carboniferous archipelago; some from the tropics with heated water, the favorite temperature of crinoids and corals, while others from temperate zones, would give entirely different orders and genera.

In this connection, permit me to ask,—in the abundant marine fauna observed by explorers, have we any examples of boreal or hyperborean species? Have we not negative proof in the absence of all Arctic species, that polar currents did not strike upon the Carboniferous shores. Thus we find evidence of the pre-existence of a Devonian and Silurian continent, lying northwards of the Carboniferous portion, forming a permanently separating barrier between the polar and tropical waters. The south and southwestern slopes of this continent were in a state of oscillation, and upon them were the coal measures laid down by tides, currents and other aqueous forces, just as the tertiary was added to the cretaceous, or the quarternary to the coasts of New Jersey or Long Island.

Williamsburgh, L. I., April 22, 1858.

Art. XI.—*On Schrötterite from Cherokee Co., Alabama;* by J. W. Mallet.

The mineral which is the subject of this notice was lately sent to me, along with several other specimens, by a gentleman of Montgomery, who requested me to examine them for supposed valuable metallic contents. They were found "at or near the falls of Little River, on the Sand Mountain, Cherokee Co., Ala.," and therefore about the junction of the Carboniferous with the Silurian or Devonian rocks of that part of the state. The fragment of rock upon which the Schrötterite occurs is a dark-colored bituminous slate, probably the "black slate" which the late Professor Tuomey has considered as representing the Devonian formation in this region.

Between this rock and the mineral a white pulverulent substance, resembling kaolin, is found. The mineral itself appears as an incrustation, one-half to three-quarters of an inch in thickness, of stalactitic structure, the individual stalactites about an eighth or a quarter of an inch in diameter, closely adherent, presenting traces of a concentric arrangement, but none of crystallization. The mere surface tends to a pulverulent appearance, is dull, nearly opaque, and slightly stained with peroxyd of iron, but this does not extend so far as to form a distinct crust. The mineral when broken closely resembles *gum arabic*; it is translucent, nearly transparent, and of the lightest possible brown tint, almost colorless. Streak white; lustre vitreous, inclining to resinous; fracture imperfect conchoidal; very brittle. Hardness =3·5. Spec. grav. =1·974.

Heated in a glass tube, the mineral gives off water, becomes opaque and white, and, when highly heated, of a light lavender-

blue color. The water collected on the sides of the tube has a slight acid reaction. Heated alone before the blowpipe on charcoal, it becomes white and opaque, intumescing quietly; on further application of heat, darkens in color, becoming smoke-gray or lavender-blue; strongly ignited, burns white again, remaining quite infusible. With nitrate of cobalt, acquires a fine blue color. With borax and microcosmic salt, on the platina wire, dissolves easily and in large quantity, forming colorless and transparent beads, which, if much mineral be present, become milky on cooling. With carbonate of soda, fuses with much effervescence to a white porcelain-like bead; if more mineral be used, an infusible white slag is formed. Dissolves easily and perfectly in hydrochloric acid, the solution, if concentrated, gelatinizing on cooling. Becomes by strong ignition very difficult of solution in acids.

Two analyses were made of the mineral, with the following results:—

	1.	2.	Mean.	Atoms.	
Silica,	10·35	10·72	10·53	·232	1·
Alumina,	46·80	46·16	46·48	·904	3·9
Water,	41·12	41·07	41·09	4·565	19·7
Oxyd of zinc,	·74	·79	·77		
Oxyd of iron, Magnesia,	*traces.*	*traces.*	*traces.*		
Sulphuric acid,	·83	·77	·80		
	99·84	99·51	99·67		

Hence the formula $\dot{A}l^4\tilde{S}i+20\dot{H}$.

The mineral differs essentially from schrötterite, to which the formula $\dot{A}l^4\tilde{S}i+18\dot{H}$ has been assigned, only in containing two atoms more of water; and since all the physical properties agree closely with those of the species described by Schrötter, the two may be fairly considered as identical. In the analysis of Schrötter, as I have seen it quoted, no mention is made of the temperature at which the mineral was dried, or whether it was dried at all, and the course pursued in this respect might perhaps account for the difference in the quantity of water, the material used for my experiments having been taken in its natural condition. In each of the two determinations of water, an attempt was made to ascertain the proportion lost at 100° C., but without very accurate result. The mineral begins to give off water below 100°, and at 100° pretty rapidly loses 8 or 10 p. c., but continues slowly to yield a little more for a long time at this temperature, so that, weighed hour by hour, it still at the end of twelve hours decreased in weight a few milligrams each time that it was placed upon the balance. At higher temperatures the water seems to be in the same way gradually driven off, and a bright red heat suffices for its complete expulsion. After twelve hours drying at 100° C., *about* five atoms of water (one-

fourth of that present) appear to be expelled; but as Professor Dana has observed in his comments upon allophane analyses,* this assumption of 100° as the temperature always separating essential from non-essential water is quite arbitrary, and it appers therefore desirable for the present to consider minerals of this class in their natural (air-dried) state. It would perhaps be possible to make, without great delay, such a series of experiments at very gradually increasing temperatures as should render evident some *real* separation of the water present into two or more portions, facilitating the escape of water by first reducing the mineral to powder. The formula preferred by Rammelsberg† for Schrötter's mineral, $(\ddot{A}l_2\ddot{S}i+12\dot{H})+2\ddot{A}l\dot{H}_3$, brings in gibbsite as a proximate constituent.

This Alabama mineral is remarkable as containing a little *oxyd of zinc*, while in Schrötter's specimens oxyd of copper was present. Small quantities of oxyd of copper also occur in almost all the published analyses of allophane, and would seem to point to oxydation of metallic sulphurets as the source of sulphuric acid, which may have afterwards taken part in the production of the allophane and allied minerals. Both in Schrötter's analyses and mine, traces of sulphuric acid itself were found.

Schrötterite having hitherto been reported from but a single locality—Freienstein in Styria—it is interesting again to find it, now in this country. I am unable to refer to the original paper of Dr. C. T. Jackson‡ upon allophane from a not very distant locality in Tennessee; it would be desirable to compare the conditions under which the two minerals occur and have been formed.

University of Alabama, March 6, 1858.

Art. XII.—*Contributions to Analytical Chemistry;* by Henry Wurtz, of New York City.

(Read before the American Association for the Advancement of Science, at Baltimore, 1858.)

Investigation of the action of nitric acid on the metallic chlorids.—
(Continued from vol. xxv, p. 384.)

29. *Cerium.*—Chlorid of cerium,§ which had a faint pink tinge due to contamination with chlorid of didymium, and probably contained also a little chlorid of lanthanum, but was other-

* Amer. Jour. Sci., [2], vol. xxiv, p. 131. † Handw. d. chem. Th. d. Min., S. 18.
‡ Proc. Bost. Soc. Nat. Hist., p. 120, 1855.
§ The cerium, lanthanum and didymium compounds used were prepared from extremely beautiful specimens of highly crystallized sulphates, for which I am indebted to the generosity of Mr. T. Sterry Hunt of the Canada Geol. Survey. The sulphate of didymium, especially, was in crystals nearly a quarter of an inch long, presenting internally a rose-colored transparency and brilliant cleavage, though the faces were ill-defined and dull, apparently from efflorescence.

wise perfectly pure, left on evaporation with excess of nitric acid a deliquescent nitrate which still contained chlorine, and the latter was not wholly expelled by two repetitions of the same treatment.

30. *Lanthanum.*—The chlorid used was also faintly tinted by chlorid of didymium, and probably not entirely free from chlorid of cerium. The nitrate, left upon evaporation with nitric acid, appeared to be much more deliquescent than the nitrate of cerium. Chlorine was retained as obstinately by it as by the latter, a trace remaining after three evaporations with nitric acid.

31. *Didymium.*—The chlorid of didymium, free from all impurities except probable traces of chlorids of cerium and lanthanum, gave similar results. The resulting nitrate (still retaining a trace of chlorine) had a violet color and was deliquescent.

32. *Thorium.*—Some perfectly pure chlorid of thorium* was decomposed with difficulty, leaving after the third evaporation with nitric acid a deliquescent nitrate, which still contained a trace of chlorine. This nitrate had a strongly astringent taste.

33. *Zirconium.*—Pure chlorid of zirconium† resisted two operations, still retaining a trace of chlorine.

34. *Molybdenum.*—Some extremely beautiful crystals of pure molybdic acid;‡ dissolved in chlorohydric acid and evaporated with an excess of nitric acid, left a residue also beautifully crystallized; containing but a faint trace of nitric acid and no chlorine. A small quantity of a *blue* substance appeared with the residue, the color of which was destroyed by nitric acid.

35. *Vanadium.*—Pure vanadic acid§ gave a beautiful green solution with chlorohydric acid, which, when evaporated with nitric acid, left a fine brown residue containing no trace of chlorine or nitric acid, and insoluble or nearly so in water, being evidently nothing but vanadic acid.

Preparations of the metals *iridium*, *palladium*, *rhodium*, *ruthenium* and *yttrium* I have been unable as yet to obtain in a state sufficiently pure to afford satisfactory results, and must therefore postpone the consideration of these, together with my general conclusions and deductions from the complete results, until a future communication.

With the chlorids of *sulphur*, *phosphorus*, *selenium*, *tellurium*, *boron*, *silicon*, *titanium* and *tantalum*, it is of course useless to experiment, for according to Berzelius, H. Davy, and others, they

* Prepared from a specimen of *orangite* (thorite) presented to me by Mr. George J. Brush, by solution in muriatic acid, evaporation to separate silica, precipitation with ammonia, solution of the washed precipitate in the smallest possible quantity of dilute sulphuric acid, precipitation of the sulphate of thoria by boiling, washing with boiling water, dissolving in cold water, precipitation by ammonia, washing and dissolving in chlorohydric acid.

† Made from some nearly pure zirconia obtained from Mr. T. Sterry Hunt.

‡ From Mr. Brush. § From Mr. Hunt.

are all readily converted by contact with water alone, either into the corresponding oxyds, or into combinations of chlorohydric acid therewith which are very unstable and decomposed by evaporation alone. *Osmium* also, according to H. Rose,* is converted by nitric acid into osmic acid, and even by *aqua regia*, no chlorid of osmium being formed in the latter case. The chlorids of *columbium* (pelopium,† niobium,‡) according to the same authority, are immediately and entirely decomposed by water into the corresponding oxyds and chlorohydric acid. So also, according to Woehler, with the chlorids of *tungsten*.§

In addition to the unsuccessful attempts alluded to in the first part of this paper to expel all the chlorine from sesquichlorid of iron by nitric acid in conjunction with the deutoxyds of lead and manganese, two others were made, using permanganic acid and chlorate of potash instead of the deutoxyds. On adding to the chlorid nitric acid and a little chameleon mineral, and evaporating to dryness, the residue still contained chlorine, and after a repetition of the same treatment, a trace was still found. With chlorate of potash, however, a successful result was obtained; the residue contained no trace of chlorine.‖

Separation of magnesia from the alkalies.

The only further results of this investigation in condition to be presented are those of some experiments to test quantitatively the separation of magnesia from the alkalies by evaporating the mixed chlorids with nitric acid, decomposing the resulting nitrates by heat, and dissolving out the potash and soda with water. For these experiments the following preparations were made:

Chlorid of sodium, by supersaturating pure carbonate of soda with pure chlorohydric acid, recrystallizing and fusing the product.

Chlorid of potassium, by recrystallizing some chlorate of potash, washing with cold water, drying, and fusing carefully and for a long time in a platinum crucible.¶ The chlorid thus obtained still retained, however, a trace of chlorate or perchlorate, for when dissolved in chlorohydric acid and boiled with a little indigo solution, bleaching took place. To test its purity therefore 0·5809 gram was dissolved in water and evaporated to dryness with an excess of pure chlorohydric acid. The residue

* Ausführliches Handbuch der anal. Chemie, i, 218.

† Ibid., i, 299. ‡ Ibid i, 307. § Gm. Handbuch. ii, 476 and 477.

‖ When water was poured on the residue, a violet or amethyst color appeared, probably due to a small quantity of *ferrate* of potash.

¶ In this operation it is necessary to project the chlorate into the crucible in very small quantities at a time, waiting until each preceding portion is entirely decomposed, as the decomposition is very violent and accompanied by great frothing.

weighed 0·5814 gram, and no longer bleached, thus showing the contamination to be unimportant.

Chemically pure *magnesia*, by igniting the pure nitrate very strongly, pulverizing the residue very finely, and washing for a long time. During the washing it absorbs carbonic acid rapidly, cakes together and forms a very hard mass resembling porcelain biscuit, so that in order to continue the washing it is necessary to pulverize it again. It was finally ignited very strongly again. Prepared in this way, magnesia is a dense heavy powder, of extreme whiteness. 0·4755 gram gave 1·2854 of pyrophosphate of magnesia, corresponding, when Schroetter's equivalent for phosphorus (= 31) is adopted, to 0·4362 of magnesia, or only 97·40 per cent of the quantity taken, the 2·60 per cent of loss being apparently due to the solubility of the ammonia-phosphate in the dilute ammonia used for washing it. Calculated upon the old equivalent of phosphorus (= 31·32) however, the determination gives 0·471 of magnesia = 99·05 p. c., a very fair result. 0.42 gram of the same magnesia was dissolved in chlorohydric acid, the chlorid converted into nitrate by evaporation with excess of nitric acid in a beaker glass, the residue transferred to a platinum crucible, dried and ignited. The residual magnesia weighed 0·4192 gram = 99·81 per cent.

0·4392 gram of the above magnesia was then taken, dissolved in chlorohydric acid, mixed with 0·6907 of the pure chlorid of potassium, and 0·9946 of the pure chlorid of sodium, water added sufficient to dissolve the chlorids, then an excess of nitric acid, and the whole evaporated to dryness in a beaker glass on the sand-bath. The complete conversion of the chlorids into nitrates may be ascertained with the utmost readiness in these operations, by the disappearance of the yellow color which the liquid assumes during the evaporation, and which it retains so long as any chlorohydric acid is present. When this color no longer reappears on adding a few drops of strong nitric acid to the hot liquid, all chlorine has certainly been expelled. The vapor from the liquid also, so long as chlorine is present, will bleach litmus paper powerfully.

After expulsion of the chlorine, the liquid was transferred to a large platinum crucible, and evaporated on the sand-bath until the residue was syrupy in consistence. Some caution is necessary during the latter part of this evaporation to prevent spattering. The cover was then placed loosely on the crucible and a high sand-bath heat applied. Red gas was evolved for a considerable time with effervescence until finally the mass solidified. On applying a gentle lamp heat, however, it again fused, and evolved red gas anew with effervescence. My object being to convert the alkalies into carbonates, a piece of platinum foil was placed in the crucible, on which was laid a lump of carbonate of

ammonia. Under these circumstances the decomposition proceeded rapidly, and the mass soon presented an appearance of tranquil fusion, with much white sediment, and evolved no more gas. The heat was finally raised to redness for some minutes. On cooling, hot water was added, the solution diluted and thrown upon a filter, together with the washings of the platinum foil and crucible cover; these, together with the crucible itself, being put aside for further use, it being found that a small quantity of the magnesia remained adhering to them. The mass remaining on the filter was washed with boiling water, and the filtrate, which had a strong alkaline reaction, heated in a beaker glass to boiling, and a current of carbonic acid gas passed through, to ascertain whether any magnesia was still held in solution. After a long time a very minute precipitate appeared, but at the same time the liquid became loaded with flitters of silica, proceeding from action of the solution of alkaline carbonates on the glass, and a slight error was thus introduced into the result. The filter with the magnesia was burned in the same crucible, the combustion being found surprisingly easy, and the magnesia weighed 0·44 gram. The precipitate obtained by the carbonic acid (with intermixed *silica*, as well as some *lime*, afterwards found in it, derived also from the glass) weighed half a milligram, making the whole product weigh 0·4405 gram, against 0·4392 taken. On dissolving the product in chlorohydric acid, the silica remained behind as a very perceptible residue, and the solution contained also a distinct trace of *platinum*, although the loss of the crucible during the operation was not more than one fifth of a milligram. In these processes, however, it would seem better to use a silver crucible.

In the above experiment no attempt was made to determine the alkalies in the filtrate, but the result with the magnesia being unexpectedly successful, for a first attempt, another experiment, with this in view, was proceeded to. 0·3627 gram of magnesia, 0·6092 of chlorid of potassium, and 0·816 of chlorid of sodium were taken. The mode of proceeding was the same as before, except that the application of the carbonate of ammonia was longer continued, and after the decomposition of the nitrates, the mass was dissolved in hot water, a feeble current of carbonic acid passed through the liquid *while still in the crucible*, and the latter heated on the sand-bath for an hour before filtering. The filtrate was supersaturated with chlorohydric acid, evaporated to dryness, the ignited residue weighed, the chlorine determined as AgCl, and the proportions of the two chlorids calculated in the usual manner in indirect analysis. The results were 0·3631 of magnesia, 0·607 of chlorid of potassium and 0·8111 of chlorid of sodium.

The separation of magnesia from the alkalies in this way may therefore be considered as an accomplished fact, and I venture to think that this mode possesses points of convenience and elements of accuracy rendering it preferable to any of those now in use. For *qualitative* analysis, and particularly for those cases in which it is desirable to combine a qualitative and a quantitative analysis in the same operation, it is particularly convenient. To *mineral analysis* also, it seems to me to be especially applicable. Use and experience will of course increase its reliability and precision, and another communication will be presented on the subject. In conclusion I may remark that similar methods promise to be applicable in numerous other cases in which metallic oxyds are to be separated from the alkalies, at least when these oxyds or their carbonates are insoluble in alkaline carbonates, and their nitrates decomposable by heat, or the vapor of carbonate of ammonia. Such bases are lime, baryta, strontia, zirconia, yttria, thoria, and the oxyds of iron, zinc, cadmium (?), copper (?), cobalt, nickel, lead, cerium and bismuth (?).

When a comprehensive investigation in which I am now engaged, having for its object to ascertain precisely the action of *heat* upon all the metallic nitrates, shall have been brought to an end, it will be possible to pronounce more definitely upon some of these cases.

Art. XIII.—*Geographical Notices.*—No. II.

Old ocean routes between England and North America.—D. J. G. Kohl, whose historical investigations in respect to the progress of discovery on the coast of the United States have been for some time in progress for the archives of the Coast Survey, has lately been publishing in the National Intelligencer (Washington, April 13 and 22, and May 1,) a series of articles on the old ocean routes between Europe and America. The subject presents many difficulties, but in the extended researches made by Dr. Kohl, much that is of value has been collected.

We append a brief statement of the routes which he discusses. In respect to each, particular information is given, which illustrates the progress of knowledge in respect to the oceanic winds and currents.

1. *The first sail from Spain to America through the region of the northeastern trade-winds, and the first home voyage from America to Spain through the region of the variable or westerly winds.* Columbus, 1492.—Under this head the remark is made that "Columbus from the outset settled the principal questions of the navigation of the central Atlantic Ocean; discovered its two

great features, the region of easterly winds, gently conducting from the Old to the New World, and the region of variable and principally westerly winds, useful for the return; and traced at once the route as well of the out-voyages as of the home-voyages of the Spanish vessels, which for a long time after him, though of course with some modifications, followed his tracks."

2. *The first Voyage from England to North America.* THE CABOTS, 1497.—The loss of papers which Sebastian Cabot wrote in respect to his voyages causes an unfortunate gap in the history of maritime discovery.

3. *The first Voyage from Portugal by way of the Azores, to Newfoundland and Labrador and back.* CONTEREAL, 1500–1.—Though the authorities on this navigator are few and vague, it is "pretty certain that his oceanic track lay between the Azores and the northern Capes of Newfoundland—that is to say, across the eastern region of the Gulf Stream, and the northeastern parts of the great Newfoundland banks."

4. *The Discovery of the Navigation of the Gulf Stream and Great Reform in the System of Spanish-American Navigation.* ALAMINOS, 1519.—"Alaminos was the first who circumnavigated the region of the trade-winds *with the greatest possible northwestern bend*, and, moreover, with the assistance of the Gulf Stream, which was unknown to Columbus and his immediate successors. Alaminos pointed out a perfectly new oceanic route, the very best and the only good one; which the Spaniards afterwards used for their return to Europe from the West Indies. Soon after him all the Spanish vessels, all the Spanish treasures from the islands, from Mexico, from Northern South America and even from Peru, went that way; and the eastern gate of the Gulf of Mexico, thrown open by Alaminos, became the principal outlet not only for this gulf, but also for the entire Mediterranean waters of America. The windward passages between the islands were now used only as *inlets* to these waters from the east. The immediate consequences of this voyage of discovery of Alaminos may be summed up thus: A better knowledge of the importance of the Gulf Stream, and of all that section of the Atlantic through which it passes; the early discovery afterward of the Bermudas; the quick rise of the harbor of Havana, which was situated at the very border of the Gulf Stream, and in the very mouth of that gate; a total change in the system of the Spanish-American navigation, and the organization of what the Spaniards called 'La Derrota de la Vuelta de las Indias,' (the return route from the Indies)."

5. *The first great French Expedition to the West, out by way of the Trade Winds, and home by way of Newfoundland.* VERRAZANO, 1524.—The Florentine Verrazano, starting from Madeira, favored by the northeasterly trades, sailed directly across the Atlantic

in about lat. 26° N. In the longitude of the Bermudas he deviated to the northwest, and reached the coast somewhere near Cape Fear, making the traverse in 49 days. "From his landfall Verrazano sailed northward along our east coast, exploring it in its whole length as far as Nova Scotia or Newfoundland," and thence returned to France by an already known route.

6. *The first traverse of the central parts of the Atlantic, from France to Florida.* RIBAULT, 1562.—"He determined to follow *a new ocean route*, which had not been attempted yet. He tells us that he struck from France at once into the broad Atlantic, and followed a more or less western course, which is, as he says, "the true and short course that hereafter must be kept to the honor of the French nation, rejecting the old conserved opinion, which so long time has been believed true:" that for reaching any part of North America, south of Canada, it was necessary to enter the trade-winds by way of Madeira and the Canary Islands. He however, unfortunately gives us no further details about the direction of his track. All that we learn about it is, that setting out from Europe westward, he saw no other coast or islands on the way, and made his landfall in about 30° north latitude, near our present St. Augustine harbor.

It is therefore very probable that he kept his course through the waters of the Azores and Bermudas. He may have passed through some regions of the ocean which never had been seen by any navigator before him. On the home track (from west to east) these central parts of the North Atlantic had been already traced by Columbus, Alaminos, and others. *But we know of no outward voyage (from east to west) which was attempted in the same direction and latitude before Ribault.*"

7. *Introduction of an important change and extension of North Atlantic Navigation by the English.* HAWKINS, 1564–5.—"Captain John Hawkins may, with full justice, be pointed out as the English discoverer of the coasts, islands, and navigation of the West Indies. All the subsequent English expeditions to America are connected with his voyages, and a host of English ships followed in his track." Three of his voyages are especially noteworthy. The first was in 1562, on which "he went beyond the Canary islands, traversed the ocean, and skirted along the northeastern coasts of the West India Islands, from which he returned to Europe by way of the sea of the Azores." On his second voyage (1564–65) he first procured a cargo of slaves on the coast of Africa, then crossed the ocean, entered the Caribbean Sea, and sailed along the south side of the Antilles, till on reaching Cape San Antonio de Cuba, easterly winds drove him into the Gulf of Mexico as high as 27° N. lat. From there he fell back to the south, rounded the Tortugas into the Strait of Florida, and, having unsuccessfully attempted to make Havana,

came in sight of the Florida Keys. Coasting thence northward to the mouth of the St. Johns river (Riviére Mai), he visited the little colony of Ribault there situated, then bore away with the Gulf Stream to the northeast, and about a month after arrived on the banks of Newfoundland, and in three weeks more reached England. His third voyage (1567–68) added to the result of his second a more thorough exploration of the Mexican Gulf. We may say, in fine, that Hawkins holds the same position in the history of English-American, as Diego de Alaminos does in that of Spanish-American navigation; the route that he pointed out became the highway for English trade and English conquest in, to, and from the New World.

8. *First consultation in England about the question, if a southern or northern voyage to the central parts of the east coast of North America would be preferable, and first attempt of a northern route.* GILBERT, 1583.—This attempt was made by Sir Humphrey Gilbert. Commanding five vessels, he ordered them to try to make Cape Race, keeping as near as possible to 46° N. lat. After a most unpropitious voyage he made land in 51° N. lat., whence he coasted southerly as far as Sable Island, (the Isle of Sablon), where the loss of his principal vessel obliged him to return. "This is the first time that authentic history shows us a navigator setting out on this now usual route from Europe for the coasts of our present United States with the pronounced conviction that it must be the best route."

9. *The First Routes of the English navigators to Old "Virginia" or North Carolina.* From 1584–1602.—The disastrous result of Gilbert's expedition brought this route into bad odor with his cotemporaries, and, this together with the more genial climate, the chance for taking Spanish prizes and sacking Spanish settlements, induced all the early Virginia voyagers—such as Raleigh, Amadas, Barlow, Mace and others—to take a southern route, reaching the West Indies about Dominica island, sailing thence along the whole chain of the windward islands, the Antilles and Bahamas, making the continent about Cape Fear, then doubling Cape Hatteras to Roanoke. By some the strong current of the Gulf Stream was thought to offer an insuperable objection to the northern route.

10. *Discovery of a more direct route from England to the North parts of Virginia, (New England).* GOSNOLD, 1602.—Bartholomew Gosnold, bearing in mind the voyage of Verrazano undertook a direct westerly route about the 40th degree of N. lat., to the shores of Virginia—the harbors of Newport and New York—and after an unfavorable passage made his landfall in 43° N. lat. This gave the cue to succeeding English navigators and became *the beaten track* to Virginia. But to us, the great interest of his journal (printed in 1602) lies in his soundings along the

North Virginian (New England) coast, and his observations on the Gulf Stream. He was greatly astonished at this warm ocean river, observed its direction and expansion towards the northeast, and calls it with great truth "a matter to set some subtle invention at work."

11. *On what route the French arrived at La Cadié, (Nova Scotia,) and the country of Arambec, (New England,) at the beginning of the seventeenth century.* DEMONTS, 1604.—It is only necessary to observe "that we find them at this time on *the true and shortest ocean route from Europe to our coasts*," the same route which Gilbert had proposed, and more correct because more northerly than that introduced by Gosnold.

12. *First Routes from England to Chesapeake Bay.* NEWPORT, 1607.—Capt. Christopher Newport was the first who ever sailed *with a special destination* for "the Bay of Chisiapiacke." He, and his immediate successors imitated him in this—went some 20° of latitude out of his way, running southward to the Canaries, then crossing to the windward islands, whence he coasted north to the mouth of the bay. Why he did so, remains a question, the more difficult to answer, as Capt. Gosnold accompanied him.

13. *Discovery of the "Ready Way" from England to Chesapeake Bay.* ARGALL, 1609.—Capt. Samuel Argall was the first who shortened this tedious route. His course is not exactly known but "it is nearly certain that he went by way of the Azores and north of the Bermudas." In a colonial letter of this date we read that his ship had been sent out from England "to goe the *ready way*, without tracing through the torrid zone, and shee performed it."

14. *First official instruction to go by a shorter route to Virginia: Official Instructions, &c., given to a large fleet in England.* SOMERS and GATES, 1609.—These were "to leave the Canaries one hundred leagues to the eastward at least and to steer directly for Virginia, without touching at the West Indies." Little is known how they were fulfilled. The fleet of nine vessels was broken up and partially destroyed by "the tail of a West India hurricane," and no satisfactory accounts preserved for us.

15. *Lord Delaware piloted through the central parts of the Atlantic from England to Virginia*, by Captain ARGALL, 1610.—Argall did this "by way of the Azores," as we learn from Lord Delaware himself. From these islands to Cape Henry occupied seven weeks,—an unusual time, and probably to be imputed to head winds. This route was not liked nor generally adopted at once.

16. *The Tracks of the First Voyages to and from the Harbor of New York, from and to the Netherlands, at the beginning of the Seventeenth Century.*—Juan Verrazano was the first European naviga-

tor who entered New York harbor. This he did from the southwest, in the year 1524. The year after Estevan Gomez came to it by chance from the northeast, and it was not visited again till 1609; when Henry Hudson thoroughly explored it, in the notable Dutch ship, Haalve Maan. The track of his return voyage, —east-southeast to latitude 30° 30′ north, then direct to England, —"may be considered as the first direct home route from New York to Europe ever performed by an European navigator." In the days of the Manhattan settlement the dutch skippers bound for New Amsterdam usually "laid their course for the Canary islands, whence they stretched across the Atlantic towards Guiana and the Caribbees, and then ran obliquely to the northwest, between the Bahamas and Bermudas until they made the coast of Virginia," usually occupying about seven weeks.

DOVE ON THE COMPARATIVE TEMPERATURE OF THE AIR AND SEA.—Prof. Dove has lately published,* with comments, tables of the temperature of the air and water, derived from observations made at Doberan and Copenhagen, on the Baltic, and at several seaports in Ireland.

The tables indicate that the excess of the warmth of the sea above that of the air is greatest in November, and that the greatest relative cooling of the sea occurs in Doberan and Ireland in May, in Copenhagen in April and May.

On the coast of Ireland throughout the year the temperature of the sea is higher than that of the air, while the water of the Baltic from March to the beginning of July is colder than the air, a fact pointing to the well known influence of the Gulf Stream.

The remarkable fact, which is brought out, that the average temperature of the water through the year is higher than that of the air, shows that the sea is a source of warmth. Two reasons, says Prof. Dove, can be assigned for this. Since the temperature of the earth everywhere upon land diminishes materially the deeper we go, the bottom of the sea would have a much higher temperature if it lay as far under a solid surface as it does under a fluid. But since it has not this higher temperature it must have given it up. As now on the surface of the sea, the cooled drops becoming heavier sink to the bottom, they take away by contact its warmth and bear it to the top, being dispossessed by new colder sinking drops. Besides this, the motion of the sea may be considered a source of warmth, since recent experiments establish that by the friction of fluids heat is generated,—which explains a fact, recognized on all sea shores, that after a storm-shaken sea the water feels warmer to the bather. However this may be, the excess of the warmth is important

* Zeitschr. für allgem. Erdk., 1858, p. 60.

enough to demand that it should be established by continued observations how far it is general, and how far limited to particular localities.

PACIFIC RAILROAD SURVEYS.—The seventh volume of the Reports of Surveys upon the Pacific railroad routes has recently been distributed, and the eighth is reported as ready for publication.

The seventh volume contains a report of explorations made between San Francisco Bay and Los Angeles, California, west of the Coast Range, and also between the Pimas Villages on the Gila River to the Rio Grande, near the thirty-second parallel of north latitude. This survey was conducted by Lieut. J. G. Parke of the Topog. Eng., assisted by A. H. Campbell. The volume also contains a geological report by Dr. Thos. Antisell, who accompanied the expedition, and a botanical report by Prof. John Torrey, beside several appendixes. At the close of the volume a resumé of the progress of all the Pacific railroad surveys is made by Capt. A. A. Humphreys, Topog. Eng., from which we abridge the following account of Lieut. Parke's expedition.

"The survey was commenced at San José, California. The route lay through the Santa Clara, or San José valley, to the Pajaro river; down the valley of the stream to near its entrance into the bay of Monterey; around the foot hills of the Gavilan range of mountains to the Salinas plains and the valley of the Salinas river, and up the Salinas river to Santa Margarita at the base of the San Luis pass. Thus far, no material obstacles were presented to the construction of a railroad; the Santa Clara valley and Salinas plains affording a peculiarly favorable location for it. A month was devoted to a thorough examination of the headwaters of the Salinas river. Reconnoitering parties were sent forward to examine the main stream and its largest tributary, the Estrella and the Cuyama plain, or valley of the Rio de Santa Maria, beyond, while a detailed survey of the San Luis pass was being made. The explorations about the heads of the Salinas and the Cuyama plain prove that a line through this country would be impracticable. An extensive basin was discovered—the Llano Estero—a tributary to the Tulare valley, which affords a very favorable pass from that valley to the bays of Monterey and San Francisco; the elevation of the summit being about 1,800 feet above the sea. The approach from the Tulare valley is over a plain for about forty miles. The distance from this pass to Kern lake is sixty-five miles. The elevation of the lake above the sea, according to Lieutenant Williamson, is three hundred and ninety-eight feet. The route was continued across the Santa Lucia mountains, through the San Luis pass, to the seashore. A detailed survey of this pass was made. It is a sharp dividing ridge, composed of slightly metamorphosed sand-

stone and serpentine rock. The elevation of the summit was found to be 1,556 feet above the sea. It is proposed to tunnel this pass for three-fourths of a mile, commencing at a point about 200 feet below the summit. The examinations in the vicinity of San Luis Obispo having been completed, the region lying between the ocean, the plains of Los Angeles, the western edge of the Great Basin, and the heads of the Tulare and Salinas valleys was thoroughly explored. The line adopted as most favorable commences at the Arroyo Grande; traverses the Gaudalupe Largo; ascends the Todos Santos summit; descends to the Rio de Tres Alamos; crosses the spur between Rio de Tres Alamos and the Santa Inez river; passes to the summit of the Gaviote pass at Santa Cruz—elevation, 700 feet—and, through the lower portion of the Gaviote pass and creek, to the coast. From Gaviote creek to San Buenaventura, the route is near the shore. It then follows the Semi plain and pass to the San Fernando plain. The Semi pass divides the San Fernando plain from the Santa Clara plain. The San Fernando and Los Angeles plains are separated by a narrow valley.

"The examinations of the coast route having been completed, the Mojave river and basin were explored and found to have no connexion with the Colorado river and basin.

"Proceeding to the Pimas villages, the initial point of the last reconnaissance, a division of the party was made; one half proceeding, via Tucson, San Xavier, and the Cienega de los Pimas, to the river San Pedro, and the other up the Gila and San Pedro valleys. In his report of 1854, Lieutenant Parke suggested the probability of finding a feasible route from Valle del Sauz to the Gila valley by passing between the Chiricahui mountains and Mount Graham, and continuing thence in a northwesterly direction, along the western base of Mount Graham to the Gila. His views in this respect were fully confirmed by the examinations of the division of the party retained under his own command. Following the Gila river to the mouth of the San Pedro, a favorable route was found for nearly the entire distance. The valley of the San Pedro proved to be wide and open; presenting no impediment to a rail or wagon road. There was an abundance of water, grass, and excellent soil, but no growth suitable for timber, though sufficient for fuel. Twelve miles from the mouth a large tributary was encountered, coming in from the east, and a party was organized for its examination. This party, descending the San Pedro for 35 miles from the Quercus cañon, crossed the mountains on the right bank to the plains west of Mount Graham, and pursuing a northwesterly course for 36 miles, found the head of the "Aravaypa" as the newly discovered stream was called. The springs mentioned by Nugent, in his notes of Hay's trip, were found in the Playa de los Pimas, and a reconnaissance was made of Nugent's pass.

The main detachment passed through the Puerto del Dado and the smaller through the wide pass, (Railroad pass,) between the Chiricahui mountains and Mount Graham; the two uniting on the Rio Sauz, about fifteen miles below the Cienega. Examinations made eastward, across the Peloncillo (Sugar Loaf) mountains, resulted in the discovery of an excellent pass for a railroad in a more direct line than that of the route of 1854. From this range of mountains an easterly course was pursued, and connexion made with the former survey about fifteen miles west of the point where Colonel Cooke's emigrant road diverges to the southwest."

AUSTRALIAN EXPLORATION.—The Athenæum for March 13, 1858, contains a letter from Capt. Freeling, Surveyor General at Adelaide, in respect to the explorations undertaken in the central part of Australia to determine whether a navigable inland sea existed there, as has been supposed. No water was found on which a boat would float. "I was away," says Capt. Freeling "more than two months, and during that time must have travelled 1,000 miles, and I verily believe that there is no other country in the world where so much barren land exists in a similar space: it is really wonderful to see the masses of stone which lie on the hills and plains as on a newly Macadamized road, as well as the absence of grass in places where the stones are not so thickly spread; but all this barrenness may easily be accounted for by the fact that but little rain falls to promote fertility. Occasionally as in March of this year, an extraordinary rain-fall occurs; then the creeks, which are for years together dry, pour down an amazing volume of water, flooding the lands in their neighborhood and eventually discharging themselves over a vast slightly hollowed plain, which then has all the appearance of a large inland sea. Test it, however, as I did by walking three miles into it, and you then see its true character, and are able to state positively that the summer heats will not have continued long before the whole is evaporated."

NEW DIVISIONS OF THE REPUBLIC OF NEW GRANADA.—By a Law of June 15, 1857, for the old division into Provinces (*Distritos* and *Cantones*) a new division into eight states (*Estados*) is substituted, with the following names and capitals: PANAMA, (Panama), BOLIVAR, (Cartagena), MAGDALENA, (Santamarta), SANTANDER, (Pamplona), ANTIOQUIA, (Antioquia), BOYACÁ, (Tunya), CUNDINAMARCA, (Bogotâ), CAUCA, (Papayan).

The outlines of these divisions are given in a chart by Kiepert, published in the *Zeitschr. fiir allgem. Erdk.*, (Jan. 1858.)

VENEZUELA—The Edinburgh New Philosophical Journal for April 1858, contains a brief report of an Expedition undertaken to explore a route by the Rivers Waini, Barama and Cuyuni, to the gold fields of Carabal and thence by Upata to the river Orinoco, by W. R. Holmes and W. H. Campbell.

UNITED STATES SURVEY OF THE COLORADO RIVER.—A letter from one of Lieut. Ives's party, now engaged in the survey of the Colorado River gives the following particulars in respect to the Expedition.

"Lieut. Ives has carried a minute hydrographic survey from the mouth of the Colorado to the mouth of the Rio Virgen, where the road to Salt Lake City approaches nearest the river. We are now descending the river to meet the mule train and to commence the survey of the upper Colorado, Virgen, etc., with the land party.

Our explorations have demonstrated the fact of the navigability of the Colorado to the mouth of the Virgen, a point far above that ever reached by any other exploring party—and the much-talked-of and much-dreaded 'Big Cañon' has been passed through in safety. Although the navigation of the river became more difficult as we approached within 60 or 70 miles of the mouth of the Virgen, we encountered no insurmountable obstacles even at this unprecedently low stage of the water, and there is now no question that with the quantity of water which flows in its channel during most of the year, and with steamers adapted to its navigation, the Colorado will afford the most feasible route for transportation of men and supplies to the region around Salt Lake. We hope to finish our land survey in three months."

MEXICAN BOUNDARY SURVEY.—The first volume of the Report of Major Emory on the Survey of the Boundary between the United States and Mexico made under the direction of the Secretary of the Interior has recently been published in a quarto form, fully illustrated. The whole work consists of two volumes divided into four parts. The first part consists of the personal narrative, general description of the country, journal of the joint commission, the astronomical work, barometrical levels, meteorological record and magnetic observations. The second part consists of the geological researches with annotations and a review of the whole by Prof. James Hall. The third part comprises the general botanical features of the country by Dr. John Torrey described from memoirs of the assistants and from the plants themselves, and a separate description of the Cactaceæ by Dr. George Engelmann of St. Louis. The fourth part embraces the natural history of the country by Prof. Spencer F. Baird based upon the notes of the assistants and the specimens themselves.

The volume now published contains a general map on a scale of 1 : 6,000,000, and other sectional maps of the boundary line and adjacent territory on a scale of 1 : 600,000—are hereafter to be given.

D. C. G.

Yale College Library, June 7, 1858.

Art. XIV.—*On the genera Orbulina and Globigerina of d'Orbigny;* by L. F. Pourtales.

Hitherto the two genera of Foraminifera established under the names of *Orbulina* and *Globigerina* by d'Orbigny had been widely separated in the classification; he had even put them in different orders, although he had remarked the similarity in the structure of the shell. Ehrenberg also places them in different families (the former under the name of *Miliola*), but marks the two genera of Miliola and Gromia as doubtful, and appends to the characteristics of the family of *Miliolina* the query, "*An status juvenilis reliquorum?*" M. S. Schultze makes of *Orbulina* a family among his *Monothalamia*, whilst *Globigerina* is included in a subfamily of the family of *Turbinoida* among the *Polythalamia*.

I think I am now able to show, by numerous preparations, that these two supposed genera are only different stages in the cyclical or alternate generation of the same species. Having had an opportunity of examining large numbers of well preserved specimens obtained from the bottom beneath the Gulf Stream by the U. S. Coast Survey, and entrusted to me for examination by Prof. Bache, Superintendent, I have found in nearly one-half of the Orbulinæ examined, young Globigerinæ more or less developed and attached to the inside of the Orbulina by numerous very slender spiculæ. Only one Globigerina is developed in an Orbulina, whose cavity it gradually fills up, and whose shell it finally bursts to make its escape. At that time the Globigerina has already nearly attained its full size, and I have counted as many as sixteen cells in a specimen having yet room for several more before filling up the parent Orbulina.

How the Orbulina-form is reproduced I have not yet traced out. None were noticed of very small size among those examined. Large individuals are frequently found containing a smaller one filling the cavity exactly; the old shell is finally cast off, and appears to remain attached in fragments to the young one for some time. I am unable to say as yet whether this is to be considered as an act of reproduction, or merely as a renewing of the shell. It is not rare to find Orbulinæ with this double shell, containing already a young Globigerina.

I hope to be able to follow out the whole chain of development of these beings; but the above facts have appeared to me interesting enough to be at once communicated.

ART. XV.—*Correspondence of J. Nicklès, dated Paris, Feb.* 28, 1858.

Electricity, by A. de la Rive.—The third and last volume of this remarkable work has just appeared after a delay of two years, caused by the necessity of studying up the applications of electricity in special directions, and therefore of acquiring knowledge in other departments. Thus the applications to medicine have compelled him to acquaint himself with physiological phenomena, and the physical applications, to become versed in the details of practical mechanics.

This third volume commences with a profound study of electricity in its relations to natural phenomena. Commencing with the physiological actions of animal or vegetable origin—he then passes to atmospheric electricity—then to terrestrial magnetism, its causes and the attendant phenomena, among which comes the Aurora Borealis, an effect according to De la Rive, of the action of electricity on terrestrial magnetism.

As to the causes of terrestrial magnetism, the author seems to adopt, with Secchi, the theory propounded by us on this subject in 1844, and brought out in this Journal in 1853.* The cause, according to this theory, resides in the sun, which acts upon the earth as in the ordinary experiment by rotation a magnet acts upon a body having a rotating movement. But whence the magnetism of the sun? The reader will find our views on that subject in the volume of this Journal just referred to.

The remainder of this volume is occupied with the applications of electricity, mechanical, physical, chemical and physiological. De la Rive has let nothing of interest escape his attention; and with the aid of his son, he has brought the whole into the plan of his work.

On the pretended formation of Urea by the oxydation of albuminoid substances.—In our correspondence of November, 1856, we announced a very important observation which to-day is contested—the transformation of proteine substances and especially of the white of an egg, into urea, through oxydation by means of Mn^2O^7KO. Mr. Staedler, Professor of Chemistry at Zurich, in repeating the experiment of Mr. Béchamp with great care, has in fact obtained a crystalline substance precipitable by oxalic acid and by nitrate of mercury; this substance was benzoate of potash, proceeding from the albumen and permanganate of potash employed. The cause of Béchamp's error, according to Prof. Staedler, is connected with the characters just mentioned based one on the feeble solubility of the displaced benzoic acid, and the other on the insolubility of benzoate of mercury.

Natural Diapason.—Mr. Cagniard-Latour, one of our principal acousticians, has satisfied himself that he hears the sound *la* of the musical scale sounding within his head when he agitates it from side to side; and Mr. Jobard has confirmed this observation in himself, and asserts that any one can verify it, if he will disembarrass his neck of the cravat and collar and place himself apart from all noise.

Mr. Jobard thus explains the fact. This natural *la* is caused by the contact of the *malleus* against the *incus* in the ear—a contact easily

* This Journal, xvii, 116, xviii, 386.

made by a rapid movement of the head. Mr. Jobard goes still farther; for according to him, those persons who, on shaking the head, hear two *la* in perfect unison are born musicians; they have the voice and ear perfectly correct. But those that hear *la* only in one ear, have an imperfect appreciation of sounds; and those who perceive two different sounds, the *la* and another note, not only do not love music, but detest and avoid it; and he proposes by this method to discover among young people those who may become musicians.

Mr. Jobard has still under enquiry, whether the note which is produced in the head by a quick motion is the same or not in all persons. The question will be of difficult solution; for the reader may remember some remarks in our correspondence of the 30th of June, 1855,* on the subject of normal diapason, showing that the *la* of the opera of Paris is different from that of the theatre of Strasbourg, Lille, Vienna and London, and that this *la* is becoming more and more elevated, so that in twenty years it will correspond to many more vibrations than now and be therefore still more acute.

Motor for the trains of the Submarine Tunnel.—Although political events in France have turned attention somewhat from the gigantic project with which we have entertained the reader in our last communication, the project still makes some progress, and its author, Thomas de Gamond, has nearly perfected his plans. The question however comes up—what kind of locomotives will be used. If steam be employed, how will ventilation be accomplished so as to keep the air respirable and rid it of the deleterious gases, carbonic acid, carbonic oxyd, sulphurous acid, and sulphuretted hydrogen, generated by the locomotive?

If the difficulty of driving air into tunnels, explained in a former communication,† be considered, it will be strongly doubted if ventilation can be thus accomplished without great cost. In order that the air should be fit for man it should not contain over *five* parts of carbonic acid in a *thousand*, especially when the oxyd of carbon is added to it. But ten trains of passengers by day and as many of freight by night would soon render the air irrespirable; for notwithstanding the great extent of the tunnel, forty-seven kilometers, the destructive condition would soon be reached—the interior capacity of the subterranean passage being only 2,324,385 cubic meters.

Foreseeing that the methods of aeration which might be used for this end would be insufficient, and considering too that the problem will not be met by substituting an electro-magnetic machine (supposing the power could be thus obtained) I propose to employ a *machine with compressed air*—which will supply

First—the motive power.

Secondly—the air necessary for use.

The experiments of Mr. Andraud and those of Mr. Julienne have been made on a scale so large as to place beyond doubt the feasibility of using compressed air for locomotion. By their experiments we know that with 1 cubic meter of air at 8 atmospheres (that is, 8 cubic meters reduced to 1), the power is obtained of transporting on rails a charge of 15 tons to a distance of 1 kilometer. A train of cars of 200 tons will then require

* This Journal, xx, 262.

† This Journal, vol. xxv, p. 96.

13·3 cubic meters of air at 8 atmospheres to run over one kilometer of road; and 625 c. m. to pass the length of the tunnel. These 625 cubic meters of compressed air will carry into the tunnel 5000 cubic meters of air of the normal pressure, so that the ten trains of the night will conduct in 50,000 c. m., or a volume 8,333 times greater than that deteriorated by the passengers on the route.*

The day trains, less heavy but more rapid, will conduct in about the same amount of air.

The pure air thus derived in twenty-four hours, will be in the ratio of 1·15 cubic meters per second, or 45 cubic meters per person. Halls of assembly are known to be exceedingly well ventilated when 10 cubic meters of pure air are received per man per hour. But the air of the tunnel, although it may be considered as confined air, will supply 10·056 cubic meters of air to each man—supposing there be 2200 passengers per day and the time of transit 70 minutes.

While then steam would soon affect respiration, there will be no ill effect in case of the use of compressed air for locomotion. No machine of this kind now exists, it is true, although its possibility has been demonstrated. But when really required, they will soon be supplied. The occasion will present itself when the tunnel of Mount Cenis shall have been constructed: its length is more than twelve kilometers, and only compressed air can be used.

The means of compressing large quantities of air for locomotion are I believe very simple. In the case of the submarine tunnel there are the fires and power rendered useless by the suppression of the steam locomotive; and besides, the winds may be used at the Pas de Calais and on the bank of Varne.

Compressed air is already in use at Mount Cenis, where it is obtained by means of water-falls, which are abundant in the Alps. The machine gives in twenty-four hours 296 cubic meters of air at eight atmospheres. The fall of water which moves it has a force of four horse power. In a communication in 1853† I described some trials by Mr. Julienne with a machine which is a steam engine of eight horse power; it furnishes in 1800 seconds, 8000 litres of air at eight atmospheres of pressure. The amount, which is less than that from the fall of water, corresponds as is seen to forty-eight cubic meters at eight atmospheres in twenty-four hours. But with a power like the wind, we can without too great cost multiply compressing machines and obtain by means of compressed air a moving power as economical as steam.

* I calculate only for adults in good health, and admit with Dumas that such a man burns 300 grams of carbon per twenty-four hours (counting as carbon the hydrogen which is consumed); 300 grams of burnt carbon correspond to 550 litres of carbonic acid. During the 70 minutes which a train will occupy in passing the tunnel, one man will consume then 14·5 grams of carbon and produce 26½ litres of carbonic acid; and a train of 220 passengers, 5,830 litres; or ten trains with 2200 passengers in all, 58,300 litres, or six cubic meters. In these calculations I take the most unfavorable case; for 300 grams of carbon is a maximum and not a mean. It is not necessary therefore to take into consideration the very interesting facts brought out by Mr. Smith (Phil. Mag., xiv, 547), and which establish, besides other things, the influence of different modes of locomotion on the quantity of carbonic acid given off in the act of respiration.—J. N.

† This Journal, xvi, 278.

Art. XVI.—*The late Dr. Robert Hare.*

During the progress of the forty years of our editorial labors, sorrow has often been awakened as we have been called to record the departure from life of friends and fellow laborers in the common cause.

Robert Hare, the distinguished chemist and philosopher, who died in Philadelphia on the 15th of last May in the 78th year of his age, is entitled to a grateful commemoration in this Journal, to whose pages his contributions were for many years more numerous than those of any other correspondent. The enumeration of the titles merely of about one hundred and fifty articles furnished by him, occupies five columns of the general index of the first fifty volumes of the Journal. He appears in forty-one of those volumes and in seven volumes of the Second Series.

For more than half a century his name has been familiar to men of science as a chemical philosopher, and to the cultivators of the useful arts throughout the civilized world.

Dr. Robert Hare was born in Philadelphia, Jan. 17, 1781. His father was an Englishman, a man of strong mind, and honored in his adopted country by the public confidence. His mother was from a distinguished Philadelphia family. In early life he managed the business of an extensive brewery which his father had established, but his strong leaning toward physical science very early manifested itself and soon led him to abandon the pursuits of a manufacturer and devote his talents and fortune to science. Before the age of twenty he gave evidence of this predilection for scientific pursuits by following the courses of lectures on chemistry and physical science in his native city and by uniting himself with the Chemical Society of Philadelphia, then embracing the names of Priestley, Sybert and Woodhouse.

In 1801 he communicated to this Society a description of the oxyhydrogen blowpipe which he then called a '*hydrostatic blowpipe.*' Prof. Silliman, having been much engaged with him in a series of experiments with this instrument in 1802–3, subsequently distinguished it as the 'compound blowpipe,' having, in fact, on his return from Philadelphia in 1803, constructed for the laboratory of Yale College the first pneumatic trough combining Dr. Hare's invention; an apparatus subsequently figured and described by Dr. Hare in his memoir "on the fusion of strontia and volatilization of platinum."* His memoir to the Chemical Society was separately published in 1801 and was republished in Tilloch's Phil. Mag., London, 1802, and also in the Annales de Chimie (1st series), v, 45.

* Trans. Am. Phil. Soc., vol. vi, p. 99, and plate 3 (June 17, 1803).

This apparatus was the earliest and perhaps the most remarkable of his original contributions to science. It was certainly evidence of a highly philosophical mind, that Dr. Hare, in that comparatively early period in modern chemistry, and when the received notions of the true nature of combustion were so vague, not to say erroneous, should have had the acumen to conceive that a stream of oxygen and hydrogen burning together should produce so intense a heat. Lavoisier, certainly one of the most acute of chemical philosophers and unsurpassed in his skill as an experimentalist, had beaten up the same path so far as to direct a jet of oxygen upon charcoal, and he thus produced a degree of heat by which he fused alumina and other bodies before deemed infusible. He had even brought the elements of water into the same vessel and had there burned them from separate jets, in his famous apparatus for the recomposition of water. But it seems never to have occurred to him that here was a source of heat greater than any then known. In our view Dr. Hare's merit as a scientific philosopher is more clearly established upon this discovery than upon any other of the numerous contributions he has made to science. His original experiments were repeated in 1802–3 in presence of Dr. Priestly, the discoverer of oxygen, then on a visit to Philadelphia, and of Silliman, Woodhouse and others. They were subsequently greatly extended by Prof. Silliman, who, with the apparatus already alluded to, subjected a great number of refractory bodies to the action of the oxyhydrogen jet and published an account of his results in the Memoirs of the Conn. Acad., May 7, 1812.

The discovery of the oxyhydrogen blowpipe was crowned by the Amer. Acad. at Boston by the Rumford medal.

The historian of science will, in view of the facts here quoted, find it needless to notice the disingenuous effort of Dr. Clark of Cambridge, Eng., in his '*gas blowpipe*,' to overlook or appropriate the discovery of Dr. Hare and the researches of Silliman and others, several years after (in 1819) this discovery had been fully before the scientific world,—an effect which must ever remain as a sad stain upon the reputation of this otherwise distinguished man.*

It is not our purpose here to rehearse the history of Dr. Hare's discovery in full, much less to describe all the modifications which the apparatus has received at the hands of its original

* The reader will peruse with interest, in this connection, Dr. Hare's elaborate defence of his own claims and those of his associate, Prof. Silliman, against Dr. Clark's appropriation, in this Journal, [1], vol. ii, pp. 281–302, 1820. Dr. Clark, after a full and spirited protest had been communicated to him, stating fully Dr. Hare's claims and the wrong done him, failed to make any acknowledgment of his error, thus exonerating us from the force of the old maxim, '*Nil de mortuis nisi bonum.*' Dr. Hare heads his strictures on Dr. Clark's book with the well-known lines of Virgil, '*Hos ego versiculos feci, tulit alter honores*,' &c.

discoverer and others. It is well known that in later years he constructed the apparatus on a gigantic scale, with large vessels of wrought iron capable of sustaining the pressure of the Fairmount water works, and that with this powerful combination he was able to fuse at one operation nearly two pounds of platinum.* In these experiments the metal is held upon a refractory fire brick and both are heated as highly as possible in a wind furnace before submitting it to the gas-jet. The product of this fusion from the crude grains is found to be greatly purified, a result probably due to the volatilization at this intense heat of some of the associate metals.

The employment of Dr. Hare's jet to illuminate light houses and signal reflectors under the names of Drummond light and Calcium light is only another example of the mode of ignoring the name of the real discoverer, of which the history of science presents so many parallels.

The fertility of Dr. Hare's inventive mind is illustrated by the numerous and ingenious forms of apparatus which he contrived for research or illustration. To many of these he was led by the necessity of preparing the illustrations for his lectures upon a scale of magnitude adequate to the instruction of the large classes of the Medical School of the University of Pennsylvania. He was called to fill the Chair of Chemistry in that institution in 1818, and continued in the discharge of its duties for nearly a third of a century, and until his resignation in 1847.

He was fond of graphic illustrations; they abound in his memoirs and in his Compendium and other works, and aided by his lucid descriptions his inventions thus become quite intelligible. Where most instructors are satisfied with less perfect and more simple means and explanations, he seemed to be content with nothing short of perfection.

During his long course of research and experimenting, he accumulated a vast store of instruments and materials. An inspection of his repositories and the treasures there accumulated filled the observer with astonishment, and in his lecture room there was always a profusion of apparatus, often instruments of great dimensions, corresponding well with his large mind, with his great physical and intellectual power and unquenchable ardor. He was himself an able and skillful mechanic, and often worked adroitly at the turning lathe and with the other resources of a well furnished shop. In his operations he spared neither labor nor expense, and bestowed both munificently for the accomplishment of his objects.

He devoted great labor and skill to the construction of new and improved forms of the voltaic pile, and it is easy to show

* Roberts in New York has lately with Dr. Hare's apparatus succeeding in fusing perfectly 53 oz. of platinum at one operation.—*N. Y. Tribune, May* 19.

that owing to his zeal and skill in this department of chemical physics, American chemists were enabled to employ with distinguished success the intense powers of extended series of voltaic couples long in advance of the general use of similar combinations in Europe. In place of the cumbrous and unmanageable Cruickshank troughs with which Davy discovered the metallic bases of the alkalies, Dr. Hare introduced his *Deflagrator*, in which any series, however extended, could be instantaneously brought into action or rendered passive at pleasure. The peculiarities of Dr. Hare's deflagrators are too familiar to need any description here. Although the discovery of the constant battery by Daniell, and of the double combinations of platinum or carbon with amalgamated zinc and nitric acid have rendered the old forms of this instrument no longer so useful as formerly, it is not less a proof of the merit of Dr. Hare's apparatus that Prof. Faraday in 1835, after having exhausted his ingenuity and experience in perfecting the voltaic battery, found that Dr. Hare had already, nearly twenty-five years before, accomplished all that he had attempted, and with a noble frankness worthy of all praise, he at once adopted Dr. Hare's instrument as embodying the best results then possible.*

It was with one of Hare's deflagrators that Silliman in 1823 first demonstrated the volatilization and fusion of carbon, a result considered so extraordinary at the time that it was long received with incredulity. Since the general introduction of Bunsen's battery these effects are no longer doubted; all Prof. Silliman's results having been confirmed and extended by Despretz, De La Rive and others.

The deflagrator was invented in 1820.† Four years earlier Dr. Hare had contrived another instrument which he called *the Calorimotor*. In this instrument great extent of surface was obtained from the combining of many large plates (18″ or 24″ square) of zinc and copper into two series and plunging the whole at one movement into a tank of dilute acid. The magnetic and heating effects of this instrument were surprising, and to this day no other form of voltaic apparatus appears to occasion the movement of so great a *volume* of heat with so low a projectile or intensitive force. By it, large rods of iron or platinum, when clamped between its jaws, are first fully ignited and then fused with splendid phenomena, while at the same time its intensity is so low that hardly the least visible spark can be made to pass by it through poles of carbon.

The magnetic effects attributed by Dr. Hare to his Calorimotor have since been shown by Prof. Henry to be attainable, as is now well known, from a single cell if combined with suitable conductors.

* Faraday's Experimental Researches, 1124, 1132.

† This Journal, [1], vol. iii, p, 105.

In the philosophy of chemistry, Dr. Hare has distinguished himself for the zeal and logical acumen with which he combatted what he conceived to be the errors of the salt radical theory. He was ready at all times to engage in controversy upon any point of theory where he conceived there was an error latent. No one can review the numerous letters which he has addressed to the Senior Editor of this Journal, to Berzelius, to Liebig and to Faraday, and published in this Journal, without perceiving that he was no ordinary antagonist.

His theory of whirlwinds and storms was founded on an electrical hypothesis, and he never admitted the rotary theory of the late William C. Redfield. Their discussions were published chiefly in this journal, and will be perused with interest and instruction both on account of the peculiar theories and of the very important series of facts which the controversy has elicited; their personal friends especially will value them the more, as the combatants, both sincere lovers of truth, have now finished their mortal career.

Mr. Redfield declined any oral controversy with Dr. Hare at the meetings of the American Association; but those who were present at the second meeting in New Haven will remember the zeal and energy with which Dr. Hare, in an off-hand speech, fluent and animated, assailed the views of Mr. Redfield, who was all the while a quiet and silent listener. The responses of the latter were always made by the pen and never on public occasions by the tongue.

In his family and among his friends Dr. Hare was very kind, and his feelings were generous, amiable and genial, although occasionally, his manner was abrupt—from absence of mind occasioned by his habitual abstraction and absorption in thought; his mind was ever active, and conversation would sometimes seem to awaken him from an intellectual reverie. He had high colloquial powers, but to give them full effect, it was necessary that they should be roused by a great and interesting subject, and especially if it assumed an antagonistic form. He would then discourse with commanding ability, and his hearers were generally as willing to listen as he was to speak.

He was a man of unbending rectitude, and a faithful friend both in prosperity and adversity.

His frame was robust—powerful and ample in structure, and of strong muscular development, having been invigorated in earlier years by skillful training; and had there been occasion, he would have made a formidable physical antagonist. His head was large and of noble model; no stranger could meet him without being impressed by a figure of such grandeur and a head and features so remarkable.

Dr. Hare was an ardent patriot, who loved his country and cherished its institutions not for office or emolument, which he

never sought or received, but from pure and lofty motives. He was of the school of Washington—an enthusiastic admirer of that great man—a federalist, while that primeval party had a name and retained vitality—and when it passed by an imperceptible transition into another form, he was found among the whigs. He occasionally wrote upon the great political and financial questions which agitate the public mind. These discussions like all his writings, were always marked by vigorous thought, large views, and elevated patriotism.

He was not however so exclusively a man of science as to ignore the charms of literature. His particular friends know that his philosophy was sometimes softened by listening to the muses, and he occasionally indulged in poetical composition.

Dr. Hare was one of the few life members of the Smithsonian Institution to which he gave soon after he resigned his profesship, all his chemical and physical apparatus, which has thus become the property of the nation.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On the crystallographical and chemical relations of Hornblende and Augite.*—RAMMELSBERG has published an elaborate investigation of this interesting and often mooted subject, and has arrived at the following results which we give in the author's own words, referring to the original paper for the very numerous analyses and formulas by which they are supported.

(1.) A series of isomorphous silicates, whose principal members are augite and hornblende, forms a larger group, that of the augites. Their structure separates them into two groups, at the head of each of which one of the two minerals stands as a type. A member of the first division by fusion passes into one of the second. Wollastonite, acmite, aegirin, babingtonite, silicate of manganese, hypersthene, diallage and spodumene, belong to the augite-type; anthophyllite and arfvedsonite, to the hornblende-type. The forms of all these minerals may be referred to each other.

(2.) The chemical character of the group is that the members are bisilicates.

(3.) The members may be classified according to the chemical character of their constituents into four divisions, which are characterized by the presence or absence of sesquioxyds.

A. Pure bisilicates of monoxyds. Wollastonite, diopside, the light colored augites generally, but also black ones rich in protoxyd of iron, hypersthene, and for the most part bronzite, rhodonite and fowlerite belong to the augite type; the light colored hornblendes, at least tremolite and actinolite, as well as anthophyllite, to the hornblende type.

B. Those which contain sesquioxyd of iron but no alumina. Acmite, aegirine and babingtonite belong to the augite type, arfvedsonite to the hornblende type.

C. Those which contain sesquioxyd of iron and alumina. These are the aluminous augites and hornblendes.

D. Those which contain alumina but no sesquioxyd of iron. Spodumene of the augite type is the only member.

(4.) The assumption of a larger quantity of oxygen in the hornblendes or of the existence of a bisilicate in them rests only in the imperfections of former analyses. The aluminous augites and hornblendes contain protoxyd and sesquioxyd of iron, the latter in addition a considerable quantity of alkalies.

(5.) Sesquioxyd of iron is everywhere present as a base and its bisilicate is isomorphous with the bisilicate of protoxyd of iron and other monoxyds.

(6.) The aluminous augites and hornblendes have an analogous constitution, which is at the same time that of all the other members, only in case the alumina is an electro-negative constituent.—*Pogg. Ann.*, ciii, 273, 435.

2. *Researches on the double nitrosulphids of iron.*—Roussin has discovered a new series of compounds containing deutoxyd of nitrogen and sulphid of iron and exhibiting in some respects a remarkable analogy to the nitroprussids of Playfair. When a solution of a per-salt of iron is added drop by drop to a mixture of solutions of an alkaline nitrite and an alkaline sulphydrate and the liquid is kept constantly agitated, a voluminous black precipitate is thrown down which on boiling dissolves almost completely. The filtered liquid deposits black crystals which are oblique rhombic prisms. They are soluble in boiling water, alcohol, woodspirit and ether. Five centigrams communicate to one litre of water the color of brandy. Their taste is styptic and afterwards bitter. The solution gives precipitates of sulphids, in many metallic solutions NO_2 being given off. The author represents the constitution of this body by the formula $Fe_2S_3, NO_2 + FeS . NO_2 + HS$, and adopts for it the name of *binitrosulphid of iron.* When the binitrosulphid of iron is boiled with a solution of caustic soda, ammonia is given off in abundance and a crystallized sesquioxyd of iron deposited. The filtered liquid deposits large black crystals which appear to have the formula $Fe_2S_3 . NO_2\ 3NaS$; the author calls this substance *sulphuretted nitrosulphid of iron and sodium.* Dilute sulphuric acid added to a boiling solution of this salt precipitates a heavy black substance which has the formula $Fe_2S_3 . NO_2$, and which the author calls nitrosulphid of iron. By dissolving this body in sulphid of sodium a new salt is obtained having the formula Fe_2S_3, NO_2, NaS, HO. This salt gives precipitates with many metallic solutions in which the metal replaces sodium. In all these compounds the iron is not indicated by ordinary tests, and the author points out their analogy to the double cyanids and especially to the nitroprussids, which last also contain deutoxyd of nitrogen.—*Ann. de Chimie et de Physique*, 411, 285, *March*, 1858.

3. *Chemical theory of gunpowder.*—Bunsen and Schischkoff have published a memoir upon this subject which not merely furnishes the

first complete solution of the problems involved in the theory of the explosion of gunpowder, but which is particularly rich in new methods of investigation and analysis. The authors from want of time were obliged to confine their researches to one kind of powder and to its combustion under the ordinary atmospheric pressure. The methods employed however will apply with slight modifications to other cases. The powder gave on analysis

Saltpeter,		78·99
Sulphur,		9·84
Carbon,	Carbon,	7·69
	Hydrogen,	0·41
	Oxygen,	3·07
	Ash,	*trace.*
		100·00

A preliminary qualitative analysis gave the following substances as solid products of the combustion of the powder employed: 1. sulphate of potash, 2. carbonate of potash, 3. hyposulphite of potash, 4. sulphid of potassium, 5. hydrate of potash, 6. sulphocyanid of potassium, 7. nitrate of potash, 8. carbon, 9. sulphur, 10. carbonate of ammonia. The gaseous products were, 1. nitrogen, 2. carbonic acid, 3. carbonic oxyd, 4. hydrogen, 5. sulphid of hydrogen, and occasionally 6. nitric and nitrous oxyds. By means of a particular apparatus the authors were able to prepare the solid residue of the explosion, the smoke or vapor which accompanies it, and the gaseous products and to analyze each separately. For the elaborate details of the analyses we must refer to the original memoir. The solid residue was found to contain

Sulphate of potash,	56·62
Carbonate of potash,	27·02
Hyposulphite of potash,	7·57
Sulphid of potassium,	1·06
Hydrate of potash,	1·26
Sulphocyanid of potassium,	0·86
Saltpeter,	5·19
Carbon,	0·97
Sulphur,	*trace.*
	100·52

The condensed smoke or powder-vapor was found to contain

Sulphate of potash,	65·29
Carbonate of potash,	23·48
Hyposulphite of potash,	4·90
Hydrate of potash,	1·33
Sulphocyanid of potassium,	0·55
Nitrate of potash,	2·48
Carbon,	1·86
⅓ Carbonate of ammonia,	0·11
	100·00

These analyses show clearly that the residues of the explosion of gunpowder consist essentially of sulphate and carbonate of potash and not of sulphid of potassium as is erroneously assumed in military books. The gaseous products of the explosion were found to be

Carbonic acid,	52·67
Nitrogen,	41·12
Carbonic oxyd,	3·88
Hydrogen,	1·21
Sulphid of hydrogen,	0·60
Oxygen,	0·52
	100·00

From this analysis it also appears that the old theory of the explosion is incorrect, since according to it nitrogen and carbonic acid should be present in the ratio of 1 : 3, whereas the actual ratio is not even as 1 : 1·5. The authors found further that 1 gram of the powder used by them gave 0·6806 gr. of solid residue and 193·1 c. c. of gas or one-third less than should be given according to the old theory. To determine theoretically the work done by the explosion, the authors first determined the quantity of heat evolved in the combustion, which was found to be in heat units 643·9 C. for 1 gram of powder. This number requires however to be corrected for the heat evolved by the combustion of the gaseous products in the combustion tube filled with air, amounting to 24·4 units, so that the true heat of combustion is 619·5 C. The calculated quantity of heat, supposing that the combustible ingredients of the powder burn freely in oxygen, is 1039·1 C.: the difference is easily explained by the absorption of heat on the part of the nitrogen set free. The temperature of the flame of the powder is found by dividing the number 619·5 by the specific heat of the products of the explosion, namely 0·207, and is therefore equal to 2993° C. When however powder burns in a space in which it cannot expand, the number 619·5 must be divided by the specific heat of the products of the combustion under a constant volume, which is 0·18547, and the temperature of the flame is therefore 3340° C. These values, 2993° C. and 3340° C., are approximations which cannot be far from the truth. The authors in the next place show that the received theory that the solid residue of the explosion of the powder exert a sensible tension is wholly unfounded since this residue does not boil at the temperature of hydrogen burning in air, which is 3259° C., and its tension even at that temperature cannot therefore equal a single atmosphere. The authors next calculate the pressure in atmospheres which the powder exerts at the moment of explosion and find it 4373·6, of which about 1000 are due to the expansion of the solid residue. The pressure which the powder employed could exert upon the sides of a cannon would, as these results show, never exceed 4½ thousand atmospheres. Hence it appears that the statements of the best authorities on artillery that this pressure amounts to 50,000 or 100,000 atmospheres are entirely without foundation in fact. One kilogram of the powder employed could exert in its explosion a theoretical work of 67410 meterkilograms.—*Pogg. Ann.*, cii, 321. W. G.

4. *Test for Cinchonia;* by J. W. Bill, Acting Surgeon, U. S. A., (communicated for this Journal).—In some investigations still in progress on some of the alkaloids it became a matter of importance to discover a good test for cinchonia delicate and characteristic and distinguishing it especially from quinia.

We think we have found such a test, and as we believe it to be a reaction not before noticed, at least not applied to the above purpose, we will

anticipate the results of the above-mentioned investigations and give the test by itself.

When ferrocyanid of potassium is added to a salt of quinia in the cold, a yellowish white cloudy precipitate falls, provided the ferrocyanid be not added in excess; otherwise nothing characteristic results. This precipitate is soluble by heat and readily so in solutions of ferrocyanid of potassium without any subsequent change occurring in the solution. If ferrocyanid of potassium be added to a soluble salt of cinchonia, whether added in excess or not, whether added to a strong or a weak solution, a yellow white curdy precipitate falls. If a very gentle heat be now applied this precipitate dissolves, but as the liquid cools again a crop of splendid yellow (gold-yellow) crystals falls so abundantly as sometimes to give a gelatinous appearance to their mass. These crystals are flat plates, cuneiform in shape, a pure lemon-yellow in color, and superimposed one upon the other in the same way as are crystals of nitrate of urea. The crystals are best observed under a low magnifying power, fifty diameters, and will then be found such as we have described them. The *precipitate* is not soluble in excess of ferrocyanid of potassium, but like this latter is decomposed by boiling with mineral acids. This test for cinchonia is a very delicate one, not less so than that by the biniodid of potassium, and is far more characteristic, since none of the alkaloids manifest the reaction except cinchonia. In practice it will be well, for obvious reasons, to use a slight excess of ferrocyanid of potassium, as little excess of acid as possible, and to heat the liquid *very* gently after the first precipitate has fallen.

5. *Note on the use of the Molybdate of Ammonia test for Phosphoric Acid;* by J. W. Bill, Acting Surgeon, U. S. A., (communicated for this Journal).—We observed on one occasion that on conducting the process for the detection of phosphoric acid in a liquid we were nearly sure contained it, that we obtained a green, a splendid chrome-green, instead of the characteristic yellow precipitate. This was observed in the laboratory of Mr. Henry Wurtz, who examined the liquid and corroborated an examination we had made proving that a soluble iodid was present as well as phosphoric acid. For a while we were puzzled to account for this phenomenon, but it appears to us that it may be explained thus.

The free nitric acid liberated some iodine and this reduced the molybdate to the state of the molybdo-molybdate, Mb_2O_5, and this in solution is a cobalt-blue. This blue liquid on being mixed with the yellow precipitate gave the green color observed. Iodid of potassium and nitric acid when added to the yellow precipitate decompose it, forming the same green colored liquid. If this is sealed up in a glass tube, in about three weeks large crystals of iodine will be found lining the sides of the tube, the liquid will have become brown-red in color and a gas will have been eliminated sufficient sometimes to have burst the tube. The reaction may be expressed in a formula thus: the yellow precipitate, the nitric acid, the iodid of potassium will give $2[NH_4O, MbO_3]+2[NO_5]+KI+PO_5=Mb_2O_5$ (molybdate of molybdenum) $+2(NH_4ONO_5)+KOPO_5+I$.

6. *On some reactions of the salts of lime and magnesia;* by T. Sterry Hunt, (Extract of a letter to J. D. Dana, dated Quebec, May 29, 1858).—In a recent paper on the earthy carbonates (*Ann. de Chimie et de Physique*, third series, vol. li, p. 302), Bineau concludes that the car-

bonates of magnesia react with the soluble salts of lime like the corresponding carbonates of the alkalies. This is so far true that a solution of bicarbonate of magnesia precipitates carbonate of lime from a solution of chlorid of calcium, while the basic carbonate of magnesia separates the carbonate of lime from its solution in carbonic acid. It results from this that when bicarbonate of soda is added to mixed and somewhat dilute solutions of chlorids of calcium and magnesium, the whole of the lime is precipitated as a nearly pure carbonate, while the magnesia remains dissolved either as chlorid, or as bicarbonate, which is much more soluble than that stated by Bischof, since according to the determinations of Bineau and my own, water may dissolve as bicarbonate more than one per cent of MgO.

I have found that when we evaporate, at from 60° to 100° F., a solution of bicarbonate of lime with an excess of sulphate of magnesia, the whole of the lime is separated in the form of gypsum, and there remains bicarbonate of magnesia in solution. The same thing happens in presence of sea-salt and chlorid of magnesium provided sulphates are present. These solutions of bicarbonate of magnesia give rise to deposits of carbonate of magnesia by further evaporation. Deville has observed that the slow action in the presence of water, between carbonate of magnesia and bicarbonate of soda, aided by a gentle heat, results in the production of a crystalline anhydrous double carbonate of magnesia and soda, analogous to dolomite, and I am led from some yet unfinished experiments to suppose that a similar reaction between the carbonates of lime and magnesia in the presence of carbonic acid may yield the double carbonate of lime and magnesia, and thus explain the formation of magnesian limestone.

7. *Boron.*—Prof. Q. Sella of Turin has published an elaborate memoir on the crystals of the so-called *adamantine* condition of boron, illustrated by many fine figures, in the Memoirs of the Turin Academy, [2], vol. xvii. The form of part of the crystals, as before described by Sella, is dimetric, and either modified octahedrons or prisms. The axis $a = 0{\cdot}576$. The forms observed are 1, *I*, 2, 2-2, 1-*i*, *i*-*i*; the face of composition 1-*i*. Wöhler and Deville mention three varieties of the adamantine boron, and these crystallographic determinations relate to the last two, neither of which is pure, one containing B 89·1, Al 6·7, C 4·2=100, and the other also holding much aluminium and carbon. The first variety consists of boron 97·6, carbon 2·4=100; and this nearly pure boron Sella finds to occur under a different form, which may be monometric (or monoclinic approaching closely to monometric); and the *Graphitoid* boron is probably the same in a fine state. The point is discussed at considerable length in the memoir.

II. GEOLOGY AND MINERALOGY.

1. *On the Order in the Coal Measures of Kentucky and Illinois and their relations to those of the Appalachian Coal-field;* by Mr. Leo Lesquereux.—In our last number we alluded to the Report by Mr. Lesquereux on the Coal Measures of the United States in the third volume of the Kentucky Geological Report. The following is the succession of the coal beds in Kentucky, (beginning with the lowest,) and some of their parallelisms with more eastern coal regions, as made out by him.

1st. Cook's coal; Bell's coal bed; Breckinridge cannel; Hawesville coal. Appears in some places to be in two beds, 1A, 1B.—1B is Lesley's B, the *mammoth coal bed* of the anthracite region (Wilkesbarre, Carbondale, Tamaqua, Lehigh, &c.), and also the best vein in Kentucky; Kenawha salines; Cuyahoga Falls, Ohio. 1A (Lesley's A) is a thin bed, the first above the conglomerates, 2 feet thick at Nelsonville, Ohio. 1½ ft. on the Great Kenawha, 1 to 2 feet on the Alleghany in Pennsylvania.

2d. "Thin Coal,"—probably Lesley's C, cannel coal of Kittanning, Peytona, Darlington.

3d. "Ice House Coal,"—probably Lesley's D, Lower Freeport, Beaver River, Cook vein (?) on Broad Top; Zanesville, Ohio.

4th. "Curlew" Coal, in Curlew Hill.—The Pomeroy coal of Ohio; Gates and Salem veins, highest of anthracite, near Pottsville, Pa., affording some fossil plants.

Next follows in order the MAHONING SANDSTONE, an important horizon.

5th. A four foot bed.—Ferns have some resemblance to those in the roof of anthracite bed, in Shamokin valley, Pa.

6th. "Little vein," Mulford's mines, Union Co., Ky.—Steiger's bed, at Athens, Ohio.

7th. "Thin Coal," seen at Saline Coal Co. property, in Illinois.

8th. Well Coal.—The *great Pittsburg* bed, 14 feet thick in the Cumberland basin; 11 ft. in Elk Lick, Somerset Co.; 9 ft. in Ligonier valley and Pittsburg; 6 ft. at Wheeling; 5 ft. at Athens, O.; or a diminution of 9 feet in 180 miles.

9th. A reliable bed in western Kentucky: at Curlew Mines; "Five foot Mulford Coal," etc.

10th. "Middle Coal."

11th and 12th. Coal under *Anvil Rock.* No. 11 (2—9 feet thick) corresponds probably to the first in limestone over the Pittsburg seam in Pa., and 12 to the next. Above the Anvil Rock, (13 and 14,) appear to correspond to others still higher in Lesley's section. Mr. Lesquereux observes that from No. 8, or the Pittsburg seam, to No. 14, is 400 feet in western Pennsylvania, and 395 in Kentucky.

The Anvil rock of Kentucky Lesley regards as on the same horizon with the conglomerate of the 12th Shamoken coal bed.*

The distinguishing fossils of these coal beds are as follows.

1st Bed. Large Trees; *Sigillaria, Calamites, Lepidodendron;* the fruits of *Lepidodendron, Lepidostrobus, Lepidophyllum,* abundant; *Stigmaria; Sphenopteris,* here and seldom seen above. Among the species, there are *Pecopteris lonchitica* only here; *Alethopteris Serlii, Neuropteris Clarksonii* and *N. hirsuta,* of which the last runs through the whole Coal Measures: *Sphenopteris intermedia, Asterophyllites ovalis, Calamites Suckovii, Lepidodendron politum, Lepidophloios rugosus. Lycopodites Sticlerianus,* etc.; *Carpolithes, Cardiocarpon, Trigonocarpon. Lingula umbonata* in the black shales in Kentucky, Ohio, Virginia, Pennsylvania.

2d. *Lingula umbonata,* etc.

3d. *Neuropteris hirsuta, N. flexuosa,* the latter also running through the Coal Measures.

* See an important paper by J. P. Lesley, on these parallelisms, Proceedings Amer. Assoc. xi, 39.

4th. *Neuropteris flexuosa, Pinnularia, Asterophyllites, Sphenophyllum* and *Annularia, Neuropteris fimbriata*, &c., *Pecopteris arborescens*, Brt., *Flabellaria boracifolia*, Sternb.; some *Calamites, Sigillaria, Stigmaria*, but no *Lepidodendron* or *Lepidostrobus* seen.

5th. *Neuropteris tenuifolia*, Br., very near *N. flexuosa.*

8th. *Pecopteris heterophylla.* Most of the species not well defined.

9th. *Avicula rectilateraria, Productus muricatus. Fish* remains. *Calamites, Sigillariæ.*

11th. *Pleurotomaria* of various species, *Productus Rogersii? Nucula Hameri? Avicula* near *A. rectilateraria. Sigillaria* seems to be wanting. Fish remains like those of No. 9.

12th. *Stigmaria, Calamites;* some scarce *Sigillariæ.*

2. *The Fossil Plants of the Coal Measures of the United States, with descriptions of the New Species in the Cabinet of the Pottsville Scientific Association;* by Leo Lesquereux. 24 pp., 8vo, with two plates. Read before the Pottsville Sci. Association, Feb. 13, 1858. Pottsville, Pa.—In this paper Mr. Lesquereux has enumerated all the known species of North American coal plants, besides describing some that are new. In all, about 300 species are mentioned; but Mr. Lesquereux remarks that already 50 new species have been collected and are not included in his catalogue; and the number when fully known will probably be near 400.

Mr. Lesquereux calls the Gates and Salem veins near Pottsville and the Pomeroy coal of Ohio, together with the beds above them (see preceding page) as the Upper Coal Measures, and the beds below, the *lower.* The lower are the *white-ash* coal, and the upper the *gray-ash* and *red-ash* of Pennsylvania. The synchronism of the Gates and Salem veins with the Pomeroy is shown by the identity of many of the fossil plants, while several of the species occur nowhere else. The following is a brief abstract of the Catalogue.

A. *Neuropterideæ.*—Fronds pinnate or bipinnate. Secondary veins either rising from a medial nerve vanishing above, or emerging and branching from the base of the leaflets without a medial nerve.

1. Noeggerathia, 6 species, all from the "Old Red Sandstone."
2. Odontopteris, 7 species, mostly from the *Lower* coal.
3. Dictyopteris, 1 species, from *Upper* coal.
4. Cyclopteris. *C. flabellata*, Brongn., *Whittleseya elegans*, Newberry, *Lower* coal.
5. Nephropteris, 8 species. Mostly from *Upper* coal. "The genus can scarcely be separated from the following, most of its species being only large deciduous leaflets attached around the main rachis of *Neuropteris.*"
6. Neuropteris, 27 species, mostly from the middle and upper coal.

B. *Sphenopterideæ.*—Frond bi-tripinnatifid or bi-tripinnate; pinnules mostly lobed, sometimes entire; nerves pinnately forking, with a primary nerve slightly distinct, flexuous; secondary nerves obliquely ascending in each division, either simple or forking near the apex.

1. Sphenopteris, 27 species. The genus includes two groups, one having round large entire leaflets belonging to the *lower* coal, the other to the *upper.*
2. Hymenophyllites, 8 species. Six would be added to Schizopteris by some authors, and these are mostly or wholly from the *upper* coal; the others are from the *lower.*

C. *Pecopterideæ.*—Frond simple? pinnate, bi-tripinnate or bi-tripinnatifid; pinnules attached to the rachis by the whole base, sometimes

united together. Medial nerve well marked; secondary nerves emerging more or less obliquely from the medial nerve, simple or furcate.

1. Asplenites, 1 species, upper coal.
2. Alethopteris, 15 species. Appear to be distributed through upper and lower coal.
3. Callipteris, 1 species.
4. Pecopteris, 25 species. Characterize mostly the upper coal, several species in the lower.

D. *Of Doubtful Family.*

Crematopteris, 1 species. Scolopendrites, 1 species. Schizopteris, 1 species, lower coal. Cannophyllites, 1 species. Cordaites, 1 species, upper coal.

E. *Asterophylliteæ.*—Includes herbaceous plants or trees, the stems ordinarily striated lengthwise.

1. Sphenophyllum, 9 species, upper and lower coal.
2. Annularia, 4 species, mostly upper coal.
3. Asterophyllites, 9 species, upper coal.
4. Calamites, 14 species, upper and lower.

F. *Stems of Trees.*

1. Caulopteris, 3 species, mostly or wholly lower coal.
2. Diplotegium, 1 species, lower coal.
3. Stigmaria, 7 species, upper and lower coal; the *Stigmaria ficoides* from the base to the top of the Coal Measures.
4. Sigillaria, 37 species, mostly lower coal.
5. Syringodendron, 3 species, upper and lower coal.
6. Lepidodendron, 18 species, lower coal.
7. Lepidophloios, 2 species, lower coal.
8. Ulodendron, 2 species, lower coal.
9. Megaphyllum, 1 species, lower coal.
10. Knorria, 3 species, lower coal.

G. *Cones, Fruits.*

Lepidophyllum, 7 species, lower coal. *Lepidostrobus*, 4 species, lower coal. *Brachyphyllum* (?) 1 species, lower coal. *Cardiocarpon*, 9 species, lower coal. *Rhabdocarpos*, 3 species. *Trigonocarpon*, 7 species, mostly lower coal. *Carpolithes*, 10 species, lower coal.

3. *On the Coal Measures of Missouri;* by G. C. Swallow.—In connection with the above it is interesting to consider the observations made in Missouri by G. C. Swallow and published in his State Geological Report for 1855. He divides the Coal Measures into the Upper, Middle and Lower. The following is an abstract of the sections, commencing above, and mentioning the most common fossils.

I. *Upper Coal Series.*

1. 10 feet of limestone. *Fossils: Fusulina cylindrica, Productus costatus, P. æquicostatus, Orthis Umbraculum.*
2. 3 feet of yellow and blue shale.
3. 3 feet of bituminous shale.
4. 3 feet limestone. *Fossils: Terebratula subtilita, Productus costatus.*
5. 15 feet of bituminous and blue shale.
6. 20 feet of limestone. *Fossils:* same as in No. 1, with also *Spirifer Meuschachanus, S. lineatus, S. plano-convexa, Productus Wabashensis, Chonetes granulifera, Terebratula subtilita.*
7. 12 feet of shale.
8. 7 feet of friable sandstone.
9. 4 feet limestone. *Fossils:* nearly as in No. 6.
10. 20 feet of shale.
11. 5 feet of sandstone.
12. 16 feet of calcareous and bituminous shales. *Fossils: Tereb. subtilita, Orthis Umbraculum, Spirifer Kentuckensis.*
13. Shaly sandstone.

14. 18 feet limestone. *Fus. cylindrica, Tereb. subtilita* (abundant), *Orthis Umbraculum, Sp. Kentuckensis, Productus punctatus, P. costatus.*

15. 17 feet of shale. 16. 3 feet of limestone. 17. 20 feet of shale.

18. 10 feet of limestone. *Fossils: Fus. cylindrica, Prod. costatus, Tereb. subtilita, Campophyllum torquium.*

19–22. 39 feet of shale with some sandstone and limestone.

23. 20 feet limestone. *Fossils:* same as in No. 14, with also, *Spirifer lineatus, S. hemiplicatus, S. Meusebachanus, Productus æquicostatus, P. Nebrascensis, Allorisma terminalis, A. regularis, Bellerophon hiulcus, Chætetes milleporaceus.*

24. 5 feet of shale. 25. Limestone, with *Fusulina cylindrica.*

26, 27. 4 feet of shale.

Thin layers of COAL occur in numbers 7, 15, 24, 27.

II. *Middle Coal Series.*

28. 5 feet of ripple-marked sandstone.

29. 30 feet of shale with mud cracks. 30, 31. 11 feet of shale.

32. ½ foot of COAL.

33. 6 feet of blue clay. *Fossils: Fusulina cylindrica, Terebratula subtilita, Orthis Umbraculum, Chonetes granulifera.*

34. 10 feet of sandstone. 35. 6 feet of shale.

36. 4 feet of limestone, the upper part shaly and full of *Fusulinæ, Chonetes, Producti, Crinoidea;* the lower hard and siliceous with huge lenticular masses of *Chætetes milleporaceus.*

37–40. 33 feet of clay and sandstone with some limestone.

41. 4 feet limestone. Contains *Ch. milleporaceus* and *Fus. cylindrica.*

42. 7 feet limestone. *Fossils: Orthis Umbraculum, Chonetes variolata, C. mesoloba, Terebratula subtilita, Fus. cylindrica.*

43. 4 feet of shale.

44. 5 feet of limestone. *Fossils: Ter. subtilita, Sp. lineatus, Fus. cylindrica.*

45, 46. 2 feet of shale overlying 2 feet of good COAL.

47, 48. 2 feet of shale over 6 feet limestone containing *Fus. cylindrica.*

49, 50. 24 feet shaly sandstone and shale.

51, 52. 5 feet of shale overlying ½ foot of COAL.

53. 6 feet of shale.

54. 4 feet of limestone. *Fossils: Allorisma terminalis, A. regularis, Prod. costatus, Sp. Meusebachanus, Bell. hiulcus.*

55. 1 foot of clay. 56. 6 feet of limestone. 57. 12 feet of shale.

58. Two-thirds of a foot of COAL. 59. 4 feet of shale.

III. *Lower Coal Series.*

60. 75 feet of micaceous sandstone, the lower part abounding in vegetable remains, *Calamites, Sigillaria, Lepidodendron.*

61. 3 feet of sandy shale; not persistent.

62. 1 foot of COAL—sometimes failing. Fossils: in earthy concretions, *Leda arata, Goniatites planorbiformis,* etc.

63. 4 feet of shale.

64. 6 feet of COAL, varying from 3 to 6 feet, and in some places wanting.

65. 1 foot of shale.

66. 8 feet of hydraulic limestone. Fossils: *Chætetes milleporaceus, Chonetes mesoloba, Productus splendens, Spirifer lineatus, S. Meusebachanus, Fusulina cylindrica, Terebratula subtilita.*

67. 6 feet of shale.

68–72. 17 feet, 3 layers of COAL, ½ to 1½ foot thick, alternating with shale.

73, 74. 5 feet of shale overlying 3 feet of COAL.

75. 23 feet of shales and fire clay.

The upper coal series has thus a thickness of about 300 feet, the middle of 200, and the lower of 150, in all 650 feet. But in other parts of the State the thickness is greater. The following fossils do not descend below the Coal Measures:

Fusilina cylindrica,
Spirifer Meusebachanus,
" plano-convexa,
" hemiplicata,
" Kentuckensis,
Productus splendens,
" æquicostatus,
Productus Nebrascensis,
" costatus,
" Wabashensis,
Terebratula subtilita (?)
Chonetes mesoloba,
" parva,
" Smithi,
Myalina subquadrata,
Allorisma regularis,
" terminalis,
Leda arata,
Pleurotomaria spherulata,
Campophyllum torquium,
Chætetes milleporaceus.

The following species are common to the Subcarboniferous Limestone and the Coal Measures: *Productus punctatus*, *P. Cora*, *P. muricatus*, *P. semireticulatus*, *Spirifer lineatus*, *Orthis Umbraculum*.

In this connection reference should also be made to the paper by Messrs. Shumard and Swallow, mentioned in our last volume, at page 447.

4. *Permian in Kansas.*—Prof. SWALLOW, in the paper announced in our last number (vol. xxv, p. 442), gives a section of the Permian rocks, taken by Mr. Hawn. According to it, they are 820 feet thick—263 of the whole being separated as the *upper* Permian, and the rest the *lower* Permian. The rocks are limestones with some shales or clay layers, and some of the limestones containing hornstone.*

Above the Permian in Kansas there are 420 feet of sandstone with some calcareous and argillaceous layers, and occasional beds of gypsum. These rocks are referred with a query to the Triassic, but may be Jurassic or Cretaceous. A *trilobate exogenous* leaf is mentioned as the only observed fossil plant, and this would favor the last conclusion. Above these beds, there are in the section 2 feet of Cretaceous rocks, and 169 of "Quarternary."

The Permian is a direct continuation apparently of the Coal Measures without unconformability. The Carboniferous rocks have a thickness in Kansas of 1070 feet, and are supposed to be higher in the series than the Upper Coal Series of Missouri. Between the Permian and the overlying strata there appears to be an entire unconformability.

Of the 75 species of fossils found in the Permian rocks and published by Prof. Swallow, only 16 occur also in the Carboniferous; yet, while the majority of the species are peculiar to the Permian, the majority of the individuals are Carboniferous. The following is a list of the Permian fossils: those that occur also in the Carboniferous are indicated by an asterisk.

Stenopora crassa, *Lonsdale.*
" spinigera, *Lonsdale.*
Chætetes, three species (*undetermined*).
Fenestella flabellata (?) *Phillips.*
Synocladia virgulacea (?) *King.*
Thamniscus dubius, *Schlotheim.*
Acanthocladia anceps (?) *Schlotheim.*
Phyllopora Ehrenbergi, *Geinitz.*
Archæocidaris Verneuiliana, *King.*
Cyathocrinus ramosus (?) *King.*
Serpula (Spirorbis) valvata, *Goldfuss.*
Spirorbis orbiculostoma, *Swallow.*
Phillipsia, *species not determined.*
Productus Calhounianus, *Swallow.*
" semireticulatus,* *Martin.*
" Rogersii,* *Norwood & Pratten.*
" æquicostatus,* *Shumard.*
" Norwoodii, *Swallow.*
Spirifer cameratus,* *Morton.*
" planoconvexa,* *Shumard.*
" pectinifera (?)* *Sowerby.*
Chonetes Flemingii,* *Norwood & Pratten.*
Orthisina umbraculum,* *Buch.*
" Shumardiana, *Swallow.*
" Missouriensis,* *Swallow.*
Rhynchonella Osagensis,* *Swallow.*
Terebratula (?) subtilita,* *Hall.*
Monotis speluncaria (?) *Schlotheim.*
" " var. Americana, *Swallow.*
" radialis, *Phillips.*
" variabilis, *Swallow.*
" Halli, *Swallow.*
Avicula gryphæata (?) *Munster.*
Pecten Cleavelandicus, *Swallow.*
" ringens, *Swallow.*
" acultialatus, *Swallow.*

* A paper on the Kansas Permian by Prof. Swallow has just been received while these pages are in type, and will appear in our next.

Mytilus (Myalina) Permianus, *Swallow.*
" " concavus, *Swallow.*
" " squamosus, *Sowerby.*
" " rectus,* *Shumard.*
Myalina subquadrata,* *Shumard.*
" Kansasensis,* *Shumard.*
Bakevellia antiqua, *Munster.*
" pulchra, *Swallow.*
Edmondia gibbosa, *Swallow.*
" Otoensis, *Swallow.*
" semiorbiculata, *Swallow.*
Nucula (Leda) Kazanensis, *Vern.*
" speciosa (?) *Munster.*
" (*species not determined*).
Solemya biarmica (?) *Verneuil.*
" (*species undetermined*).
Solen (?) Permianus, *Swallow.*
Cardiomorpha rhomboidea, *Swallow.*
" Kansasensis, *Swallow.*
Cardinia cordata, *Swallow.*
" subangulata, *Swallow.*
Cardina (*species undetermined*).
" Listeri (?) *Sowerby.*
Pleurophorus (?) Permianus, *Swallow.*
Schizodus obscurus, *Sowerby.*
" triangularis, *Swallow.*
" Rossicus, *Verneuil.*
Lyriodon (Myophoria) orbiculare, *Goldf.*
Allorisma lanceolata, *Swallow.*
" curta, *Swallow.*
" Minnahaha,* *Swallow.*
Murchisonia subangulata (?) *Vern.*
" Kansasensis, *Swallow.*
" perversa, *Swallow.*
Loxonema fasciata, *King.*
Macrocheilus spiratus, *McCoy.*
Naticopsis Pricei,* *Shumard.*
Nautilus Permianus, *Swallow.*
" occidentalis, *Swallow.*
Orthoceras Kickapooense, *Swallow.*
Cyrtoceras dorsatum, *Swallow.*

The following species, viz., *Spirorbis valvata, Monotis speluncaria* var. *Americana, M. radialis, M. variabilis, Avicula gryphæata, Myalina Permiana, M. concava, Bakevellia antiqua, Solemya, Solen* (?) *Permianus, Schizodus Rossicus, Murchisonia subangulata* (?), *Nautilus Permianus, Orthoceras Kickapooense, Cyrtoceras dorsatum,* occur only in the Upper Permian. *Monotis Halli* is alone in occurring in both the upper and lower Permian. These results may be much modified by farther discovery.

Messrs. Meek and Hayden, in their paper on the Permian of Kansas published just before the above-mentioned paper by Prof. Swallow, (see our last volume, p. 442,) describes the following species as new: *Monotis Hawni, Myalina* (*Mytilus*) *perattenuata, Leda* (*Nucula*) *subscitula, Bakevellia parva, Edmondia? Calhouni, Pleurophorus? occidentalis, P.* (*Cardinia*) *subcuneata, Lyonsia* (*Panopœa*) *concava, Panopœa Cooperi, Nautilus eccentricus.*

5. *Descriptions of New Organic Remains collected in Nebraska by Dr. F. V. Hayden,* Geologist to the Exploring Expedition under the command of Lieut. G. K. Warren, Top. Engineer, U. S. A., together with some remarks on the geology of the Black Hills and portions of the surrounding country; by F. B. Meek and F. V. Hayden. 20 pp., 8vo. From the Proceedings of the Acad. Nat. Sci. of Philadelphia, March, 1858.—An abstract of this paper is given in the last volume of this Journal, pages 439, 440. Besides the subjects there referred to, it contains descriptions of several species of fossils, Tertiary, Cretaceous, and others from beds supposed to be Jurassic.

6. *Notice of Remains of Extinct Vertebrata from the valley of the Niobrara river;* by Joseph Leidy, M. D. 10 pp., 8vo. From the Proceedings of the Acad. Nat. Sci. Philad., March, 1858.—The letter from Dr. Leidy, published on page 441 of the last volume of this Journal, contains an abstract of this highly interesting paper on the collections made by Dr. Hayden. The names of the species described are as follows:

Carnivora.

Canis sævus.
" temerarius.
" vafer.
" (Epicyon) Haydeni.
Felis (Pseudælurus) intrepidus.
Aelurodon ferox.

Rodentia.

Hystrix (Hystricops) venustus.
Castor (Eucastor) tortus.

Ruminantia.

Cervus Warreni.
Merycodus necatus.
Procamelus occidentalis.
Megalomeryx Niobrarensis.
Merycochoerus proprius.
Merychus (*Leidy*) elegans.
" medius.
" major.
Anchitherium (Hypohippus) affinis.
" (Parahippus) cognatus.
Equus excelsus.
" (Protohippus) perditus.
Merychippus (*Leidy*) insignis.
" mirabilis.
Hipparion s. Hippotherium occidentale.
" " speciosum.

Pachydermata.

Rhinoceros crassus.
Mastodon (Tetralophodon) mirificus.
Elephas (Euelephas) imperator.

In an appendix to this paper Dr. Leidy adds a statement of the additional discovery of two other species of *Camels* in the Niobrara region,—one of which he calls the *Procamelus robustus*, and the other *P. gracilis*. The former was about the size of the modern camel, and the other not larger than the Lama.

7. *Note on the Genus Graptolithus;* by JAMES HALL. (The Canadian Naturalist and Geologist, iii, 139.)—The observations of Mr. Hall are throwing great light on the characteristics of Graptolites. His specimens from New York, and the Canada Geological Survey are very numerous and various. In several, the Graptolites are much branched, and somewhat stellate in appearance, consisting of two nearly similar halves somewhat bifurcately divided in a plane, and proceeding from a common stipe and united together about the central parts by a membrane or corneous disk. Others are simple, and *show all the stages of growth from the simple young individual to the compound branched form*. The article in the "Canadian Naturalist and Geologist" describes and figures some of the branched forms, and is from Mr. Logan's forthcoming Geological Report. Mr. Hall thus characterizes the genus Graptolithus:

"*Description.*—Corallum or bryozoum fixed, (free?) compound or simple? the parts bilaterally arranged, consisting of few or many simple or variously bifurcating branches, radiating more or less regularly from a centre, and united towards their base in a continuous thin corneous membrane or disk, formed by an expansion of the substance of the branches, and which in the living state may have been in some degree gelatinous. Branches with a single or double series of cellules or serratures, communicating with a common longitudinal canal, affixed by a slender radix or pedicle from the centre of the exterior side."

"In its living state we may suppose it to have been concavo-convex (the *upper* being the concave side), or to have had the power to assume this form at will. In many specimens there is no evidence of a radix or point of attachment, and they have very much the appearance of bodies which may have floated free in the ocean."—p. 142.

He adds farther:

"It will appear evident from what follows, that heretofore we have been compelled to content ourselves for the most part, with describing *fragments* of a fossil body, without knowing the original form or condi-

tion of the animal when living. Under such circumstances, it is not surprising that various opinions have been entertained, depending in a great measure upon the state of preservation of the fossils examined. The diminution in the dimensions, or perhaps we should rather say in the development, of the cellules or serrations of the axis towards the base, has given rise to the opinions, advanced by Barrande, that the extension of the axis by growth was in that direction, and that these smaller cells were really in a state of increase and development. In opposition to this argument, we could before have advanced the evidence furnished by *G. bicornis*, *G. ramosus*, *G. sextans*, *G. furcatus*, *G. tenuis*, and others, which show that the stipes could not have increased in that direction. It is true that none of the species figured by Barrande indicate insuperable objections to this view; though in the figures of *G. Serra* (Brong.) by Geinitz, the improbability of such a mode of growth is clearly shown.

"It is not a little remarkable that with such additions to the number of species as have been made by Barrande, McCoy, and Geinitz, so few ramose forms have been discovered; and none so far as the writer is aware, approaching in the perfection of this character to the American species.

"Maintaining as we do the above view of the subject, which is borne out by well-preserved specimens of several species, we cannot admit the proposed separation of the Graptolites into the genera *Monograpsus*, *Diplograpsus*, and *Cladograpsus*, for the reason that one and the same species, as shown in single individuals, may be *monoprionidean* or *diprionidean*, or both; and we shall see still farther objections to this division, as we progress, in the utter impossibility of distinguishing these characteristics under certain circumstances. We do not yet perceive sufficient reason to separate the branching forms from those supposed to be not branched, for it is not always possible to decide which have or have not been ramose, among the fragments found. Moreover, there are so various modes of branching, that such forms as *G. ramosus* present but little analogy with such as *G. gracilis*.

"Mr. Geinitz introduces among the *Graptolitideæ* the genus *Nereograpsus*, to include *Nereites*, *Myrianites*, *Nemertites*, and *Nemapodia*. Admitting these to be organic remains, which the writer has elsewhere expressed his reasons for doubting, they are not related in structure, substance, or mode of occurrence, to the Graptolites, at least so far as regards American species; and the *Nemapodia* is not a fossil body, nor the imprint of one, but simply the *recent track of a slug* over the surface of the slates. The genus *Rastrites* of Barrande has not yet been recognized among American *Graptolitideæ*. These forms are by Geinitz united to his genus *Cladograpsus*, the propriety of which we are unable to decide.

"The genus *Gladiolites* (*Retialites* of Barrande, 1850, *Graptophyllia* of Hall, 1849) occurs among American forms of the *Graptolitideæ*, in a single species in the Clinton group of New York. A form analogous, with the reticulated margins and straight mid-rib, has been obtained from the shales of the Hudson River group in Canada, suggesting an inquiry as to whether the separation of this genus on account of the reticulated structure alone, can be sustained. In the mean time we may add that the Canada collection sustains the opinion already expressed, that the *Dictyonema* will form a genus of the family *Graptolitideæ*. The

same collection has brought to light other specimens of a character so unlike anything heretofore described, that another very distinct genus will thereby be added to this family. The Canadian specimens show that the Graptolites are far from always being simple or merely branching flattened stems."—pp. 140, 141.

These remarks are followed by descriptions of several species.

8. *Reminiscences of Arctic Ice Travel in search of Sir John Franklin and his companions;* by Capt. F. L. M'Clintock, R. N., *with Geological Notes and Illustrations;* by the Rev. Samuel Haughton, M. A., Prof. Geol. Univ. of Dublin. 68 pp., 8vo, with 9 plates and a colored Arctic geological map. From the "Journal of the Royal Dublin Society," Feb. 1857.—Capt. M'Clintock was in the Arctic under the command of Sir James C. Ross, on his expedition in search of Franklin, and afterwards in command of H. M. Screw-steamer Intrepid, under the orders of Capt. Kellett, C. B., of the Resolute.

He was connected with two sledging expeditions; the first, in 1849, started from Port Leopold, lat. 74° N., long. 90° W., in the northeast corner of North Somerset, and followed the north and part of the western shore of that large island; the second, in 1851, started from Griffith's Island, in lat. 74½° N. and 95½° W., and explored the southern part of Melville Island. In the summer of 1852 he was again at Melville Island in command of the Intrepid. From a port on the south side, Capt. M'Clintock crossed the island to the north and passed over also to Prince Patrick Land beyond, between 115° and 121° W., and 76° and 78° N., which he partially examined. The last excursion occupied 105 days and extended over 1400 miles.

The geological formations met with and colored on the map are as follows: the colored part of the map covers the area between 75° and 125° W. and between 72° and 78° N.

(1.) *Granitic or crystalline rocks:* over eastern North Devon, long. 80°—82½°, lat. 74½—75¾°; western North Somerset, near long. 95°; in scattered boulders over many other parts of the islands.

(2.) *Upper Silurian and Devonian:* over the northern part of Cockburn Island, 73°—73¾° N., and 75°—90° W.; the larger part of North Somerset; Cornwallis Island; all but the eastern part of North Devon.

(3.) *Carboniferous limestone:* over the islands or parts of islands lying *north* of lat. 76°, from Grinnell Land on the east (93° W.) to Prince Patrick Land on the west. This limestone is stated to *overlie* the coal-bearing sandstones.

(4.) The *Coal-bearing sandstones* (referred to Subcarboniferous): over the same islands as the limestone, but *south* of 76°: including Bathurst Land, 75°—76° N., 99½°—104° W.; Melville Island, from its southern shore to 75° 50′ N.; Byam Martin Island between Bathurst and Melville; part of Eglinton Id., west of Melville, south of 75° 50′; Baring (or Banks) Land, 72½°—74½° N., 115°—125° W.

(5.) *Jurassic rocks:* over a small peninsula on the eastern side of Prince Patrick Land; also at islets Exmouth and Talbe, north of Grinnell Land, in long. 95° W., lat. 77° 10′ N.

Viewing the range or direction of the whole, the line between the "*Carboniferous* limestone" and the "coal-bearing sandstones," according

to the map, is nearly straight between E. 5° N. and W. 5° S. In the coal-bearing sandstone region, two parallel outcrops of coal are marked as existing on Bathurst Land and southeastern Melville Island, and on the intervening island of Byam Martin, the distance between the two lines eight or ten miles; also a third outcrop in Melville Island, and along the same line in Baring Land to the southwest. The strike is represented as uniform between E.N.E. and W.S.W., and is deduced from the observed occurrence of coal at Cape Hamilton on Baring Island, Cape Dundas on Melville Island, also Bridport Inlet and Skene Bay on Melville Island; on Byam Martin Id.; and at Shomberg Point and Graham Moore Bay on Bathurst Island.

The following are the fossils observed—beginning at localities to the eastward.

(1.) *Silurian and Devonian.*

a. North Devon. Cape Riley (74° 40′ N., 92½° W.) *Favistella Franklini.*

b. Possession Bay (73° 30′ N., 77° 20′ W.) and Cape York (73° 50′ N., 87° W.), a brown earthy limestone, which at the latter place contained a coral near *Favosites Gothlandica.*

c. North Somerset.—At Garnier Bay (74° N., 92° W.), *Cyathophyllum helianthoides* of Goldfuss, *Heliolites porosa* (also in Devonian of England), *H. megastoma, Cromus Arcticus* (the trilobite *Encrinurus levis* of Anselm, according to Salter), *Atrypa Phoca* Salter, *A. reticularis, Columnaria Sutherlandi* Salter, various *Brachiopods*, and a *Cyathophyllum.*—At Port Leopold (73° 50′ N., 90° 15′ W.), *Calamopora Gothlandica!* ("unquestionably identical with the celebrated fossil of Goldfuss") *Rhynconella cuneata*, and a *Cyathophyllum; Loxonema M'Clintocki.*

d. Beechy Island (74° 40′ N., 92° W.).—*Atrypa Phoca* (*Rhynconella Phoca* of Salter) abundant, *Atrypa* ———, an *Orthoceras*, many species of *Loxonema*, forming sometimes a Loxonema limestone, Crinoidal limestone, *Clisiophyllum Austini, Chætetes Arcticus, Syringopora reticulata, Calophyllum phragmoceras, Cyath. cæspitosum, C. articulatum*, (Edw. and Haime), *Fav. Gothlandica?, F. alveolaris?, Favistella Franklini.*

e. Griffith's Island (74° 35′ N., 95° 30′ W.).—*Cromus Arcticus, Orthoceras Griffithi* Haughton, an *Orthoceras* with lateral siphuncle and simple circular outline of septa, *Loxonema Rossi, Strophomena Donnetti* Salter, *Calophyllum Phragmoceras* Salter, *Syringopora geniculata, Macrocheilus* ———? Crinoidal limestone.

f. Cornwallis Island (74° 40′ N., 94° W.).—*Orthoceras Ommaneyi* Salter, *Pentamerus Conchidium* Dalman, *Cromus Arcticus, Cardiola Salteri, Syringopora geniculata* (also found in the Irish Carboniferous).

(2.) *Coal-bearing Sandstone of Lower Carboniferous.*

a. Bathurst Island.—Graham Moore's Bay (75° 30′ N., 102 W.). *Coal* of the usual quality.

b. Byam Martin Id. (75° 10′ N., 104° 15′ W.)—An *Atrypa* near *A. primipilaris* of v. Buch and the *A. fallax* of the Carboniferous rocks of Ireland in a yellowish gray sandstone. *Coal.*

c. Melville Island.—Cape Providence (74° 20′ N., 112° 30′ W.), Crinoidal limestone, apparently like that of Griffith's Island; yellowish gray sandstones; clay ironstone.—Winter Harbor (74° 35′ N., 110° 45′ W.). Yellow and gray sandstone.—Bridport Inlet (75° N., 109° W.). *Coal* with impressions of *Sphenopteris*, clay ironstone.—Skene Bay (75° N., 108° W.). *Bituminous Coal*, associated with brown crystalline limestone, and grayish yellow and reddish sandstone.—Hooper Island (75° 5′ N., 112° W.). Clay ironstone, sandstone and *Coal.*—Cape Dundas (74° 30′ N., 113° 45′ W.). Fine specimens of *Coal.*

d. Baring Island.—Ballast Beach (74° 30′ N., 121° W.). Wood fossilized by brown hematite.—Princess Royal Islands (72° 45′ N., 117° 30′ W.). Clay ironstone, brown hematite (pisolitic), grayish yellow sandstone, *Terebratula aspera* Schlotheim (abundant in the Eifel); native copper from the Esquimaux.—Cape Hamilton, grayish yellow sandstone, like that on Byam Martin's Island, *Coal.*

(3.) *Carboniferous limestone.*

a. Bathurst Island, north coast, at Cape Lady Franklin (76° 40′ N., 98° 45′ W.) *Spirifer Arcticus* Haughton, *Lithostrotion basaltiforme.*

b. Melville Island.—Hillock Point (76° N., 111° 45′ W.). *Productus sulcatus* (also European), *Spirifer Arcticus.*

(4.) *Jurassic.*

Prince Patrick's Land.—Wilkie Point (76° 20′ N., 117° 20′ W.). *Ammonites M'Clintocki, Monotis septentrionalis, Pleurotomaria* ——? *Nucula* ——?

A review of what was previously known on Arctic geology is given by A. K. Isbister in the Quarterly Journal of the Geological Society, vol. xi, p. 497 (1855), and the paper is cited in this Journal, vol. xxi, p. 313–338 (1856). This article gives also a list of previous publications on the subject.

One of the most important results brought out is the seeming establishment of the conclusion, long since announced, that the sea temperature of the Arctic zone in the Silurian, Devonian and Carboniferous ages, was not essentially different from that in the temperate zone. The study of the geographical distribution of animals is showing that species have but a narrow range of temperature in which they can flourish in full vigor, and even families and tribes have often but a limited range. 20° F. (between 68° and 88°) is the whole range of the existing coral reef corals —and species have still more restricted limits. The existence therefore of the same species of corals, molluscs and trilobites, or of *closely related or representative*, if not identical, species, in latitudes 40° and 75°, leads to but one conclusion. The near uniformity of the climate is at once suggested, and must be admitted until this life-thermometer reads otherwise. Whether the relative size of related species indicates a degree of difference is yet undetermined.*

The Jurassic fossils extend the same approximate uniformity onward to the Jurassic period, or prove a recurrence of it, if it had been interrupted. The Ammonite, *A. M'Clintocki*, is stated to approach the *A. concavus* of the lower Oolite. The author remarks on page 41, "The fossils are all small, and of only a few varieties, some being Ammonites, but the greater part bivalves." "I picked up also what appeared to be a fossil bone (*Ichthyosaurus?*) only part of it appearing out of the fragment of the rock." The *supposed* Ichthyosaurian bone was afterwards lost. Jurassic fossils have also been found at Katmai Bay or Cook's Inlet in northwest America (60° N., 151° W.); and Dr. Grewingk mentions the species as *Ammonites Wosnessenski, A. biplex?* (the *A. biplex* of Mayen from Jurassic deposits in the Andes in latitude 34°, south of Valparaiso, is stated to be not distinguishable from this), *Belemnites paxillosus*, and *Unio Liassinus.* Professor Haughton remarks upon the fossils of Prince Patrick's Land (p. 62), "The discovery of such fossils *in situ* in 76° north latitude, is calculated to throw considerable doubt upon the theories of climate which would account for all past changes of temperature by changes in the relative position of land and water on the earth's surface. No attempt, that I am aware of, has ever been made to calculate the number of degrees of change possible in consequence of changes of

* The facts plainly show that the argument employed on pages 78, 79 of this number by Mr. Stevens is defective. Moreover there was not only a wider uniformity of climate at that early period, but also greater comprehensiveness in all the earth's conditions and changes.

position of land and water; and from some incomplete calculations I have myself made on the subject, I think it highly improbable that such causes could have ever produced a temperature in the sea at 76° north latitude which would allow of the existence of Ammonites, especially Ammonites so like those that lived at the same time in the tropical warm seas of the south of England and France, at the close of the Liassic and the commencement of the lower Oolitic period."

9. *Descriptions of New Tertiary Fossils from Oregon and Washington Territories, and new Cretaceous species from Vancouver's Island, collected by Dr. Evans;* by Dr. B. F. SHUMARD, (Trans. Acad. Sci., St. Louis, 1858, p. 120).—The Tertiary species are *six* in number, the Cretaceous *two*. The latter are *Inoceramus Vancouverensis* and *Pinna Calamitoides*. They are stated to occur with a *Nautilus* (apparently identical with *N. DeKayi* of Morton and other species) in an argillaceous limestone.

10. *Report of a Geological Reconnaissance in California*, made in connection with the Expedition to survey routes in California to connect with the surveys of routes for a railroad from the Mississippi river to the Pacific Ocean, under the command of Lieut. R. S. Williamson, Corps Top. Engineers in 1853; by WM. P. BLAKE, Geologist and Mineralogist of the Expedition. With an Appendix containing descriptions of portions of the collections by Prof. L. AGASSIZ, A. A. GOULD, M.D., Prof. J. W. BAILEY, T. A. CONRAD, Prof. JOHN TORREY, Prof. GEORGE C. SCHAEFFER, J. D. EASTER, Ph.D. 336 pp., 4to, with numerous wood-cuts and 4to plates. New York, 1858. H. Bailliere.—This volume is a separate publication (with some corrections) of a part of the fifth volume issued by the general government, on the subject of the Explorations and Surveys for a Railroad route from the Mississippi River to the Pacific Ocean. Mr. Blake by his explorations has been enabled to make important contributions to our knowledge of both the topography and geology of California. The Report commences with an "Itinerary or notes and general observations upon the geology of the route." He then takes up the "Geology of portions of the Route,—of the vicinity of San Francisco and Monterey,—the Tulare valley,—the Tejon Pass and Cañada de las Uvas,—the southern part of the Great Basin,—the Colorado Desert,—closing with notes on the Gold Region. Some notice of the observations on the orography was given in our last number; and in previous volumes we have published part of the results of Mr. Blake's observations either in notices of his preliminary publications or in communications from himself. These notices are as follows: on the Colorado Desert, vol. xvii, p. 438; on the Cinnabar mines, xvii, 438; review of preliminary Report, xix, 433; on the Gold region of California and its minerals, xx, 72; on the grooving of rocks by sand, xx, 178; descriptions of fossil shells collected in California, from the Tertiary (Eocene and Miocene) by T. A. Conrad, with remarks in conclusion on the Tertiary by Mr. Blake, xxi, 268; notice of fossil fishes collected in California by Mr. Blake, by L. Agassiz, xxi, 272; evaporation at the Tulare lakes in California, xxi, 365; and also observations on Marcou's geological map, xxii, 383. We might still quote from the volume at great length to the advantage of our readers, but it is not necessary, as it is now made accessible to geologists by the author, through a separate publication. Besides numerous views,

maps and sections, there are the following plates—1 of fossil shark's teeth to illustrate Agassiz's appendix; 11 of Eocene and Miocene Tertiary shells, by Conrad; 1 of sections of silicified wood, by G. C. Schaeffer; 10 of new species of plants described by Dr. Torrey.

11. *On the parts of California and Oregon explored by* Lieut. R. S. Williamson, Topog. Eng., and Lieut. H. L. Abbott, Topog. Eng., in 1855, being the sixth volume of the Reports of Explorations and Surveys to ascertain the most practicable and economical route for a railroad from the Mississippi river to the Pacific Ocean.—This volume commences with the General Report by Messrs. Williamson and Abbott, presenting important observations on the general topography, productions and inhabitants of the country examined, and special details relating to the proposed railroad route. Among the statements we find that Shasta Peak is estimated at 18,000 feet in height above the sea, and that its two peaks are "loaded with eternal snow." It is of interest to compare with this the aspect in October, 1841, as sketched with minute attention to the position of the snow by J. D. Dana, and published in this Journal, vol. vii, p. 249. From the amount of snow there shown, it is plain that the height is less than 14,000 feet. It is stated in the text that the peak was seen early in November, and it snowed there on the night of November 9th; whereas in 1841 there had been no snow or rain during the autumn until the time of the visit.

This Report is followed by a Geological Report by Dr. J. S. Newberry, Geologist and Botanist of the Expedition. The following facts are cited from its pages.

San Francisco Sandstone.—The San Francisco sandstone and shale, which in some places pass into talcose slate and jasper rock, are referred to the Tertiary, as done by Mr. W. P. Blake, and the associated serpentine is regarded as probably eruptive. An analysis by J. D. Easter shows that it is common serpentine in composition. No fossils have yet been found to place beyond doubt this reference of the slates and associated rocks to the Tertiary.—A *Scutella* (*S. interlineata*) is washed up on the shores, on the Pacific side of the San Francisco axis, and it is supposed on lithological grounds that the rock (a sandstone) as well as the fossiliferous Miocene sandstones to the eastward, is the same in age as that about San Francisco.

At *San Pablo Bay*, the Miocene sandstone dips 30° to 35° to the eastward; it consists of sandstones overlaid by fossiliferous beds, these by other sandstones and shales without fossils, and these by conglomerates and tufas. The fossils are species of Pecten, Mactra, Nucula, Tellina, referable to the Miocence according to Conrad. Above the whole lies a horizontal layer of oyster shells four feet thick, about twenty feet above the present water level. The oyster is a living species. The same sandstone formation is continued through the Straits of Carquines, as others have described, and occurs also about Benicia, where shark's teeth were collected by Mr. Blake. A jasper hill occurs five miles from Benicia, which resembles the jasper rock near San Francisco; and at the north end of the ridge there is a copious spring, slightly thermal, the temperature 80° to 90° F.

Mount Diablo is partly made of Miocene Tertiary strata abounding in fossils. There are also serpentine rocks, actinolite, diallage; and gold has been found in the streams running from the mountain.

There is a mystery as to the connection between the metamorphic rocks, including talcose slate, serpentine, talc, actinolite and jasper rock of the coast region, and the fossiliferous sandstone, which remains to be solved. There are serpentine and actinolite associated with the talcose slates on the north side of the Bay of San Francisco which were not a product of eruption, as we know from observation; and it appears to us altogether improbable that any of the serpentine is eruptive. There is a problem here for future investigation. The hot springs of Wam Chuck valley (see beyond) afford a hint on the subject.

Cretaceous (?) strata on Chico Creek, northern part of the valley of the Sacramento.—A calcareous sandstone on Chico creek in the foot hills of the Sierra Nevada, as first described by Dr. Trask, contains species of the genera *Mactra*, *Tellina*, *Nucula*, *Fusus*, *Turritella*, *Natica*, etc., along with *Baculites* and *Ammonites*. Two of the species, a *Nucula* and *Mactra*, according to Conrad, are very similar to miocene fossils of Astoria on the Columbia, the *N. divaricata* and *M. albaria*;* and these have been regarded as proving that the deposits, although containing Cretaceous genera, are Tertiary. But Dr. Newberry observes that it is more probable, as all the other species are undoubtedly new, that these also are so, and that the deposits are Cretaceous. Above Chico Creek the Sacramento valley rapidly narrows.

Volcanic Cone near Bear Creek.—A cone 500 or 600 feet high occurs in Bear Creek Valley, near Fort Reading. It has a crater and there are lava streams in its vicinity, and much obsidian with tufa deposits.

Cretaceous and Carboniferous fossils near Fort Reading.—Dr. Trask has described a fine Ammonite from a locality a few miles southwest of Fort Reading under the name of *Ammonites Batesii*, collected by Dr. Bates.

East of north of this fort the mountains contain limestone strata of the Carboniferous age, having great thickness. They were first mentioned by Dr. Trask. The fossils are *Spirifers*, species of *Orthis*, *Encrinal* stems, and *Cyathophylloid corals.*

Mt. Shasta—Lassen's Bute—Coal.—Mt. Shasta and Lassen's Bute connect with the Sierra Nevada and bound the elevated plateau of the interior; the eastern base of these mountains, being 4000 feet higher than the western. At McCumber's, 25 miles beyond Fort Reading, good *coal* has been found, according to Mr. McCumber. The plateau is about 4000 feet above the sea. Dr. Newberry saw no specimens.

Lassen's Bute is a volcanic cone, about 9000 feet high, and feldspathic lavas covered the region around.

Three Sisters.—In the vicinity of the parallel of 44° by the head waters of the Des Chutes river, the Three Sisters were near by—really five in number; the highest 10,000 to 11,000 feet in height, the group stands at an angle in the Cascade range. While standing at the pass,—to the north the snow-clad peaks of Mt. Jefferson and Mt. Hood were in sight,

* See Expl. Exp. Report by J. D. Dana, Appendix on the Fossils of Astoria by Mr. Conrad.

to the southwest-by-south appeared Mount Pitt, and then south from this peak, Mt. Shasta; from Mt. Shasta, the range was deflected eastward to Lassen's Bute, and thence stretched on south again. The axis of the Cascade range is set nearest to its western limit; the declivities eastward are few and steep, while westward there is a broad mountainous belt, gradually diminishing in altitude. Besides the lofty cones, there are many other craters along the range. Between the snowy mountains of the Three Sisters, a large crater and recent lavas were passed at a height of 6,500 feet above the sea.

Glacial action.—The north wall of this crater consisted of black porphyry, and was everywhere scored as if by glacial action. The groovings continued down the northwest and southwest sides of the mountain and in the latter direction they were traced for several miles to a point over 2000 feet below the line of perpetual snow. These evidences of glacial action reach over a wide extent of country and prove a condition of climate in former times widely different from the present.

Des Chutes Basin.—This basin consists of a series of plateaus from 4000 to 2200 feet in elevation above the sea, each covered usually by a floor of columnar igneous rock. The igneous rock overlies tufas and conglomerates neatly stratified, and alternates at times with other doleritic layers. At the eastern base of the Three Sisters, the plateau is 4000 feet high. The evidences of igneous action were seen in lava streams, besides a cone of scoria, and Mt. Jefferson with its ejections. Approaching Mt. Jefferson, the progress of the party was arrested by a cañon 1950 feet deep: standing on one side on metamorphic slates, they looked across to the black and rugged slopes of the great snow-covered mountain.

The tufas were partly of white, pink, blue and other fancy colors; some varieties were highly infusorial, and *freshwater* in species, according to Prof. Bailey. They contained numerous trunks of trees, sometimes fossilized and sometimes in the condition of decayed wood.

Hot Springs. Metamorphic action.—In the valley of the Wam Chuck there are numerous hot springs, two of them having a temperature of 143° and 145° F. The water holds large quantities of dissolved silica, and gelatinous silica was floating in it; the sides of the springs were incrusted with a siliceous deposit. The tufa cliffs are intersected by steam from fissures and the hot waters, and the layers are so changed as to resemble "serpentine or some light colored volcanic or metamorphic rock which has undergone complete fusion." The extreme form of metamorphism is a variety of *jasper*. The pumiceous tufas first have the cement hardened, and semicrystallized; then the whole takes a buhrstone aspect, the space occupied by the pumice being empty or nearly so; finally, at the third stage of change, the cavities are filled with onyx in horizontal layers of red, white and green colors, or with opal, or more rarely agate. The results arise evidently from the hot siliceous waters acting on the tufas and marls. Silicified wood is very abundant, as it is over much of Oregon and California.

Infusoria.—Infusorial remains were collected in the basins of Pit river, Klamath, the Des Chutes and the Columbia, as well as at Monterey, and many other points on the coast, to Shoalwater, Washington Territory. Prof. Bailey found in every case that all the specimens from the east of

the Cascade or Sierra Nevada were of *freshwater* species of Diatoms, while those from near the coast were marine. In the stratified tufas and conglomerates of the interior no animal remains but infusorial were found.

Mount Hood (*South side of the Columbia*).—Showers of ashes have been discharged several times from Mt. Hood since the country was settled by the whites. Mr. Dryer of Portland who attempted the ascent in 1854, states that steam and heated gases were escaping from its summit in many places at the time of his visit.

We have thus culled a few facts from Dr. Newberry's valuable geological report. It is accompanied by descriptions of Tertiary fossils by Mr. Conrad, from California and the Isthmus of Darien: and it is followed by a second Report by Dr. Newberry on the Botany of the route, illustrated by plates.

12. *Report on the Explorations in California to connect with the routes near the 35th and 32nd parallels, and also the route near the 32nd parallel between the Rio Grande and Los Pimas villages;* by Lieut. John G. Parke, Topog. Eng., in 1854 and 1855; being the seventh volume of the Reports of Explorations and Surveys, &c., over the Rocky Mountains.—The General Report of Lieut. Parke occupies the first 40 pages of this volume, and is then followed by the *Geological* Report of Thomas Antisell, M.D., Geologist of the Expedition, covering 196 pp., 4to.—The geological examinations of Dr. Antisell in Southern California extended over the counties Santa Cruz, Monterey, San Luis Obispo, Santa Barbara and Los Angeles. He commences with a general account of the Coast ranges. He mentions the parallel ranges south of San Francisco. The *first* along the coast, is the Santa Cruz range, having in Santa Cruz and Santa Clara an average altitude of 2000 feet: the length 85 miles; strike N. 70° W. The *second* range extends from the southern shores of San Pablo and the straits of Carquines; in Alameda county and Santa Clara, its altitude is as great as for the Santa Cruz range. The *third* is the Mount Diablo range. Mt. Diablo is near 55 miles inland, and has a height of 3800 feet. The range is not a continuous one, it dropping down occasionally to low hills. East of this range is the valley of San Joaquin; and beyond this, the Sierra Nevada.

The counties of Santa Barbara, Los Angeles and San Diego are remarkably subject to earthquakes; the average number for the last six years is more than nine a year.

In the southern part of California no strata have been found between the Tertiary and the crystalline rocks in age. Dr. Antisell remarks that "there is no good evidence that the southern portions of California were so circumstanced as to receive any of the mud or siliceous deposits of the palæozoic age." But this is an unwarranted inference; for it is by no means improbable that the crystalline rocks are the palæozoic strata metamorphosed.

The Tertiary of these southern counties is Miocene in age, and is divided between two or three epochs—(1) "that of the deposition of the brown sandstones with traces of lignite as in the sandstones of Monte Diablo and Gavilan; (2) the calcareous beds of the valleys, as at Santa Margarita and the Estrella valley: and (3) the quartzose, bituminous and polythalamous beds of the coast. The first or lower are estimated to have a

thickness of 1200 feet, the middle of 610, and the upper of 400 feet, making in all 2211 feet. The Tertiary of the Estrella valley, Santa Inez mountains and San Raphael hills, Mr. Conrad states, is parallel with that of the James and York rivers in Virginia; there are gigantic Pectinidæ in each and the *Pecten Magnolia* of the Pacific Tertiary may be identical with *P. Jeffersonius* of Virginia. This Estrella Tertiary is probably of later age than the Santa Barbara. Mr. Conrad adds, "I have no doubt that the Atlantic and Pacific oceans were connected in the Eocene period; and the fossils herein described afford strong evidence that the connection existed during the Miocene period." All the species of Tertiary fossils, except perhaps two, differs from those found by Mr. Blake.

Chapter 17 of the Report closes the observations on Southern California, and after it follows chapters on the geology of the interior region along from San Diego to Fort Yuma and thence to the Pimas villages. Gypsiferous beds were met with south of the Gila and east of its tributary, Rio San Pedro, in 110° 30′ W., which are referred to the Cretaceous, but no fossils were found to remove all doubts.

The Report is illustrated by sections and two maps, but the sections are much distorted and seem to be generally a result of very hasty observations.

13. *Descriptions of New Species of Blastoidea from the Palæozoic rocks of the Western States, with some observations on the Structure of the summit of the Genus Pentremites;* by B. F. Shumard, M.D. 12 pp., 8vo, with one copper-plate. Ext. from Acad. Sci., St. Louis, Vol. I, No. 2.—This paper describes two new species of *Codaster* and three of *Pentremites*. The author shows that the mouth aperture and the ovarial apertures around it are each covered by a group of small calcareous plates. The paper closes with a table of the genera and species of the family Blastoidea found in the western and southern portions of the United States, including twenty-one species of *Pentremites*, three of *Codaster* (M'Coy), and one of *Eleutherocrinus* (Shum. and Yan.) *Three* of the *Pentremites* are from the Upper Silurian (Lower Helderberg group); *two* from the Devonian (one from the Upper Helderberg and one from the Chemung); and the rest from the Carboniferous (Sub-carboniferous period); eight of them in the Encrinal limestone, and eight in the Archimedes limestone. Of the species of *Codaster*, two are Devonian (Upper Helderberg) and one Carboniferous (Encrinal limestone). The species of *Eleutherocrinus* is from the Upper Helderberg.

14. *New Trilobites from the Lower Silurian rocks of Canada;* by E. J. Chapman, Prof. Min. and Geol., University College, Toronto. 9 pp., 8vo, with a wood-cut. (Canadian Journal, Toronto, for May, 1858.)—The author describes two large species of Asaphus, both new, the *Asaphus Canadensis* and *A. Halli*. The former occurs in the Utica shale of the townships of Whitby and Nottawasaga, Canada West. The largest specimen was five inches in length. The second species, *A. Halli*, is from the Trenton limestone of Peterborough, and one of the specimens is six inches long.

15. *On the Assaying of Coals by the Blowpipe;* by E. J. Chapman. 12 pp., 8vo. (Canadian Journal, Toronto, for May, 1858.)—This is an important paper, giving, with much detail and precision, methods for

determining the volatile ingredients, coke, ash, sulphur, &c., of mineral coals by means of the blowpipe alone.

16. *On the Parallelism between the Deposits of Auriferous Drift of the Appalachian Gold-field and those of California;* by WILLIAM P. BLAKE. (From a letter addressed to J. D. DANA, dated Dahlonega, Ga., April, 1858.)—I have just completed a tour of exploration in the gold region of North Carolina and Georgia, and am much impressed with the close similarity of the gold deposits to those of portions of California. The great difference between the two regions appears to be in the scale upon which they are developed. In California the mountains are higher, the streams larger, the river-valleys deeper, the gold-drift heavier, and the gold coarser and more abundant than in Georgia. But though there is this difference in the scale of development, the similarity is preserved in the configuration of the surface and in the distribution of the gold. In topography the elevated and undulating surface of the Cherokee lands in Lumpkin county, Georgia, much resembles the "divides" or elevated lands between the forks of the American River in California. The hills are formed of gneiss and mica slate on edge, traversed with auriferous quartz veins, and covered with beds of drift as in California. Gold occurs not only along the streams in gravel, but is found high on the hills under accumulations of river-drift, gravel and clay. It is evident in Georgia, as in California, that the rivers once ran at a much higher level, even on the tops of the present hills. River-gravel and gold is found here from 200 to 300 feet above the streams. Many of these deposits on the hills give evidence of great richness but have never been worked, owing to the distance of the earth from water and the expense of excavating and carting it to the rivers. Owing also to the difficulty of prospecting these high places, without water at hand, their value has never been fully known or appreciated.

In North Carolina the elevated placers are now being washed by the hydraulic method with great success. Through the energy and perseverance of Dr. M. H. VanDyke, a former resident of California, water is supplied to them by a canal several miles in length, winding about on the sides of the hills, and at one point the water is carried across a valley, more than half a mile wide, in a flume supported upon trestles one hundred feet above the ground. This water is delivered at such a height above the placers that they are rapidly washed away before the jets, and the gold is thus secured.

The gold from these placers is not as coarse as in most of the high placers of California, but it is similar in the form of the particles. Black sand is very abundant and coarse, and contains zircon, corundum, kyanite, garnets and other minerals not yet determined.

17. *On Tennessee Geological History;* by Prof. JAMES M. SAFFORD. (From a letter to J. D. DANA, dated Lebanon, Tennessee, March 31st, 1858.)—There is an example of unconformability between the Lower and Upper Silurian in Tennessee which has not attracted the notice it deserves. There appears to have been an island in the Upper Silurian and Devonian seas, occupying about a central position with reference to the present limits of the State. This island was perhaps 80 or 90 miles in diameter. It was elevated apparently at the close of the Lower Silurian

age, and was then not under the sea again until the commencement of the period during which the "black slate" was deposited. Such I infer to be the case from the following facts:

1st. Within an area which I know to be from 40 to 50 miles from east to west and about 80 from north to south, the black slate, wherever it is exposed, rests directly upon rocks of the Hudson period, the intermediate upper Silurian and Devonian beds being absent. This may be seen in part by referring to my geological map of Tennessee.

2d. Where the absent rocks first appear around the area mentioned they have an inconsiderable thickness, often but a few feet, thinning out, in fine, as we approach the supposed ancient land, and thickening slowly and uniformly in the opposite direction, thereby separating more and more the black slate and lower Silurian rocks.

3d. No evidence of the denudation of the absent rocks, previously to the deposition of the black slate has been observed.

Upon the whole I think there is good reason to believe that such an island or dry land existed. It was most likely low—a depressed dome, but little above the water. The sea around it was shallow, slowly deepening, as the distance from the land increased. On the west and south sides of this land, limestones for the most part were deposited; while on the north and northeast sides there was a much larger proportion of shale and sandstone. The materials of these deposits came perhaps from the northeast, the sand and heavier parts falling first, the calcareous and finer portions being carried farther, perhaps around the island to its west side, &c. However, take what view of it we may, these beds referred to afford an interesting example of unconformability between the lower Silurian and the formations above.

18. *Permian in Illinois.*—The existence of the Permian in Illinois has been recently recognized by Prof. James Hall from specimens received by him from Mr. Worthen. The following letter from Dr. J. G. Norwood, relating to the same region, has been published in the Proceedings of the St. Louis Acad. Sci., 1858, 115.

"I beg leave to submit for the consideration of the Academy the following remarks on some of the rocks of Illinois, which overlie the main Coal Measures in several counties of this State.

In 1855–6, while making examinations in the La Salle coal-field, I found in the upper beds a number of organic remains which were entirely new to me, but belonging mostly to genera liberally distributed through the Coal Measures of this and the neighboring States. Being associated with Coal-Measure fossils and intimately connected with beds of coal, they were considered to belong to the true Carboniferous era. In the winter of 1856, I caused drawings to be made of some of them, with the intention of describing them in connection with the late Mr. Henry Pratten. Since his death these drawings have not been found. Last summer Mr. H. A. Ulffers wrote out descriptive notes of several new *Producti* and *Chonetes* from the localities alluded to, to be used in a small monograph on *Producti* and *Chonetes* which I was then having printed, but which still remains unfinished.

My attention was not especially directed to a comparison of these fossils with organic remains peculiar to rocks of the Permian system, as

established by Sir Roderick Murchison and other European geologists, until since the announcement, made by Prof. Swallow, of Missouri, of the existence of Permian rocks in the Territory of Kansas, which was soon followed by the publication of the same fact by Mr. F. B. Meek and Dr. F. V. Hayden. Having thus had my attention directed to this subject, after a review of some of the fossils found in Bureau, La Salle, and Henry counties, I have become satisfied that the upper beds at least of the La Salle rocks are of the same age as those containing many of the organic remains described by the gentlemen above named as belonging to the Permian rocks of Kansas.

Among the fossils are *Pecten Cleavelandicus* Swallow, *Mytilus squamosus* Sow., *Productus Norwoodii* Swal., *Monotis radialis?* Phil., *Edmondia Murchisonia?* King, *Leda* (*Nucula*) *subscitula* Meek and Hayden. In a paper which I am preparing for the Academy, the whole fauna of these rocks will be noticed so far as I am acquainted with it, and a comparison instituted between that and the underlying Coal Measures. In the mean time, I enclose a vertical section of the rocks at one point in La Salle County.

The beds are composed of sandstones and conglomerates, magnesian limestone, slates, and red and blue gypseous marls, all of them resting unconformably on the underlying beds. In addition to the beds named, three thin seams of coal occur in the rocks alluded to as seen in the section: thus showing, that, if this formation shall be proved to belong, undoubtedly, to the Permian period, the great probability is, that the upper beds of coal in several sections of the State are of the same age. This is rendered almost certain from the very partial examination I have been able to make of the organic remains from other localities. I may also mention the occurrence in the slates of scales of a *Platysomus*, a genus that belongs to the Permian epoch.

Section of the rocks at La Salle—descending.

No.		*ft.*	*in.*
1.	Bluish and reddish clay shales,	14	8
2.	Limestone (brecciated), -	15	8
3.	Gray shale, irregular, -	4 to 6	
4.	Gray compact limestone, fossiliferous, - - -	14	9
5.	Black slate, irregular, - -		6
6.	Shaly limestone, very irregular in thickness, - - -		8
7.	Coal, - - - - -		1
8.	Limestone, - - - - -	26	8
9.	Shale, gray, - - - -		1
10.	Gray limestone, - - -		7
11.	Gray shale, - - -		5
12.	Blue limestone, - - -		5
13.	Black slate, - - -		7
14.	Coal, - - - - -		5
15.	Blue shale, - - - -	9	5
16.	Limestone, - - - - -	1	6
17.	Coal, - - - -		1
18.	Fire clay, - - - -		3
19.	Shale, - - - - -	9	3
20.	Limestone, - - - - -	3	5
21.	Coal, - - - -		1
22.	Fire clay, - - - - -		3
23.	Blue shale, - - - - -	17	1
24.	Gray limestone, - - -	3	5
25.	Blue shale, - - - - -	9	5
26.	Gray limestone, - - -	2	5
27.	Blue shale, - - - - -	12	
28.	Blue limestone, - -	2	
29.	Blue shale, - - - - -	1	
30.	Black slate, - - -	2	5
31.	Blue shale, - - - - -	13	
32.	Hard limestone, - -	4	
33.	Blue shale, - - - - -	2	7
34.	Blue limestone, - -		5
35.	Red shale, - - - - -	2	
36.	Limestone, - - -		3
37.	Red shale, - - - - -	4	5
38.	Brown shale, - - -	10	
39.	Sandstone, - - - - -	18	
40.	Siliceous shale, - - -	19	
41.	Slaty shale, - - - - -	11	6
42.	Black slate, - - -	6	
43.	Coal, - - - - -	4	5

This section embraces only a portion of the rocks of La Salle, while in Bureau County, beds occur which overlie all those here given.

I will forward to the Academy, as soon as completed, a notice of the geology of that region, together with that of such other sections of the State as appear, from a comparison of their fossils, to be of the same age.

Springfield, Ill., March 31, 1858."

19. *Report on the Survey of South Carolina*, being the Second Annual Report to the General Assembly of South Carolina, embracing the progress of the Survey during the year 1857; by Oscar M. Lieber. 142 pp., 8vo, with plates and maps. Columbia, S. C.—After an introductory chapter, on veins and mining, this Second Report by Mr. Lieber takes up the geology of Union and Spartanburg Districts in South Carolina, which is illustrated, for each, with a colored map. The order in the rocks recognized is the following, commencing above: I. Blue limestone; II. *Itacolumitic* Group, including, *a.* Itacolumite, *b.* talcose slate and Catawbarite, *c.* white or mottled limestone, *d.* itacolumite, *e.* itabirite and specular schist, *f.* itacolumitic conglomerate and fine grained itacolumite; III. Group below the itacolumite, *a.* clay slate, *b.* talcose slate, *c.* mica slate, *d.* gneiss.—Besides these there are the *igneous* rocks, which are divided into the *granitic* and "*trappean*," the former including granite and eurite, the latter diorite, aphanite, minette, aphanitic porphyry, schistose aphanite, dioritic slate, saponite (meaning soapstone). We suspect that even the granite and diorite, as well as most of the other so-called trappean rocks will turn out to be metamorphic, like mica slate and gneiss, when the geology of the region has been more studied. The *aphanite* (which is made identical with *melaphyre*,) is, *in part* at least, a true trappean rock and resembles the dolerite or trap of New England. But the schistose aphanite is described as scarcely distinguishable from hornblende slate, and as possibly metamorphic. There seems to be little reason to doubt its metamorphic origin. The gneiss is described as differing but slightly from the granite in structure, but as containing less of hornblendic beds. There are very few if any valuable mineral veins in the gneiss. The mica slate contains the Cameron Galena mine and the iron mines at the Cowpens and at the Hurricane Shoals. Over the clay slate lies the itacolumite. At the top of Gilkey's Mountain, in Northern Union, Mr. Lieber found this rock passing into a coarse sandstone and conglomerate, showing that itacolumite is throughout a metamorphosed sandstone; some of the pebbles of the conglomerate are an inch and a half in diameter. The best specimens of the flexible variety may be obtained near Limestone Springs in Spartanburgh District. Gold has never been found in the itacolumite of South Carolina. With the itacolumite occurs the *Catawbarite*, a talc rock containing magnetic iron ore in lenticular beds; the *specular schist*, a quartzose mica schist consisting largely of specular iron; and *itabirite*, a similar rock containing as largely of magnetic iron. The iron ore is of excellent quality and in great abundance. The author describes with valuable detail the mines of gold, copper, lead and iron of the regions, and treats also in a following chapter of the soils and agriculture. The maps are neatly colored, and instructive.

20. *Preliminary Report on the Geology and Agriculture of the State of Mississippi;* by L. Harper, LL.D., State Geologist of Mississippi.

By order of the Legislature of Mississippi. 350 pp., 8vo, with plates of sections. Jackson, Miss., 1857.—This Geological Report on Mississippi is very unequal in its different parts, and requires a careful revision before it can become good authority. Many of the sections have a fantastic boxing off of layers, which is untelligible to us. Certain rocks are pronounced to be Carboniferous, because the genus *Productus*, occurring in them, is not known to exist, the author says, in older strata. Some peculiar concentric aggregations in clay are attributed to whirlpools in the waters. The work argues against the subdivision of the Eocene proposed by Conrad, on very insufficient data, and an evident want of appreciation of the subject. There are errors also in the identification of the Cretaceous, Tertiary, and Post-tertiary beds, which betray insufficient observations and an imperfect acquaintance with the science.

The survey of the State of Mississippi is now vigorously prosecuted by Mr. Eugene W. Hilgard.

21. *Description of a New Genus of Fossil Edentate;* by L. Nodot, Director of the Museum of Natural History at Dijon. 176 pp., 8vo, in the Mem. de l'Acad. Imp. des Sci., etc., de Dijon, 5th volume, 2d series. —This elaborate paper besides describing a new genus near Glyptodon, announces several new species of the genus Glyptodon, and brings out some general views on classification. Besides, it is illustrated by twelve fine lithographic plates in 4to. The new genus is called *Schistopleurum*. In *Glyptodon* the tail is inflexible and conico-cylindroid in form; in *Hoplophorus* it is inflexible, short, and massy in form; in *Schistopleurum* it is long, flexible, and verticillate. The two new species of Schistopleurum are *S. typus* and *S. gemmatum*. The form is very convex, or oblong globular, the length in the former in a straight line 1·68 meters, the breadth 1·21. The *Glyptodon tuberculatus* is a third species. The number of new species, of Glyptodon proposed is six, besides which, the author mentions three described by Owen. These fossil Edentates are all from the Pampas of southern South America in the vicinity of Buenos Ayres and Montevideo, and in Brazil.

Mr. Nodot divides the genera of loricate Edentates into the *Carnivorous* and *Herbivorous*. The former including *Euphractus*, *Chlamyphorus*, *Priodontes*, *Tatusia*, *Dasypus*, *Xenurus;* the latter, *Tolypeutes*, *Euryodon*, *Heterodon*, *Chlamydotherium*, *Schistopleurum*, *Glyptodon*, *Hoplophorus*, *Pachytherium* (?). All but *Tolypeutes* of the herbivorous are extinct species. The two series are nearly parallel to one another. In the proposed classification, an oblong ellipse is drawn; *Euphractus*, and *Chlamydotherium*, as the types of the two divisions, are placed at the foci; and then the genera of the carnivorous at intervals in the periphery to the left, the herbivorous in the same to the right, the representative genera of the two being arranged on the same transverse line. Moreover, besides Euphractus and Chlamydotherium on the middle or diametral line, Orycteropus, an aberrant carnivorous form, is placed at the upper extremity, and Pachytherium at the other. Our readers are referred to the Memoir for full explanations of the author's views.

22. *Etudes sur le Metamorphisme;* par M. Delesse, Ingenieur des Mines. 300 pp., 8vo. From the Annales des Mines, [5], xii, 89, and 417.—To be completed in a following number of the Annales des Mines.

—Mr. Delesse has confined his observations, in the work here cited, to the metamorphism or alteration produced at the contact of an igneous rock with another it traverses, regarding this subject, correctly, as a proper introduction to that of metamorphism in general. He divides his work into *first*, the metamorphism of the *encasing* rock; and *second*, the metamorphism of the *eruptive* rock. The different kinds of eruptive and encasing rocks are reviewed in order, and afterwards the various examples of alteration which have been observed in connection with each, either by Mr. Delesse or other geologists, are carefully described. The locality and condition of the rocks are described, the normal or unaltered state, and then the altered state, taking into the consideration the specific gravity, the proportion of water and carbonic acid, and the mineralogical and chemical composition. As preparatory to the whole, the effects of the simple action of heat on the various rocks are dwelt upon at some length.

The plan of the work is thus comprehensive and complete. The 300 pages thus far published treat only of changes in the *encasing* rocks, where the eruptive rock is (1.) *Lava*, and (2.) *Trappean rock*. The part relating to cases where the vein is *granitic* is yet to be published. The discussion is preparing the way for the right consideration of the metamorphism of rock strata; and we shall look with interest for the future writings of Mr. Delesse on this subject.

The main difficulty in carrying out the separation between metamorphism connected with eruptive rocks and metamorphism not so connected, arises from the uncertainty of the line dividing off the two groups of altered and eruptive rocks from one another. Granitic veins are generally regarded as eruptive in all cases; and yet there is no evidence that in very many cases not only granite rocks (granite, syenite, &c.) may be metamorphic, but even granitic veins may be only an incident connected with metamorphism—a result of the opening of fissures deep down towards the interior heat, where heat and water brought in material from either side to fill the cavity, instead of an opening quite through to a source of liquid rock: for the characters of mineral veins prove the fact that such non-eruptive granitic veins have been made. Or the seeming vein may be only a metamorphosed sedimentary layer that once alternated with other sediments which now make the encasing rock—which through upturning or folding and displacement by disturbance and semi-fusion, have been thrown into vein-like forms. How then, in such doubtful cases, shall the line be drawn between the effects adjoining eruptive veins and those adjoining the non-eruptive? We look for light on these points in the following part of the work. The subject is illustrated by three folded plates full of figures and sketches, representing sections, veins, rock structures, and other particulars connected with metamorphism.

23. *Paléontologie de l'Ile de Sardaigne;* par le Professeur Ch. J. Meneghini, ou Description des Fossiles recueillis dans cette Contrée par le Général Albert de la Marmora. 586 pp., 4to, with eight large folded plates. Turin (Imprimerie Royale), 1857.—Professor Meneghini, the author of this great work on the Palæontology of the island of Sardinia, is one of the able corps of professors at Pisa, the author of works both on minerals, fossils, and some departments of zoology. The present work treats of all the Sardinian formations from the Silurian to the Pleistocene.

In the oldest fossiliferous strata only an imperfect cast of an Orthis was observed, and the precise age is undetermined. The next in the series contains species of *Tentaculites*, *Ptilodictya*, *Stictopora*, *Favosites*, etc. The next, *Murchisonia* near *M. carinata* of Hall, *Spirifer Terebratuliformis*, M'Coy, *Orthis elegantula*, *O. testudinaria*, *O. Patera*, Salter, *Ptilodictya lanceolata*, Lonsdale, etc. Over a dozen species of Graptolites are described from a succeeding stratum. In another above there are fifteen species of Orthoceras, several of them new, among them *Orthoceras Bohemicum* of Barrande. From this rock, there is a transition to the Carboniferous strata. The coal plants described are species of *Sigillaria*, *Cordaites*, *Odontopteris*, *Cyatheites* (11 species), *Alethopteris*, *Pecopteris*, *Oligocarpia*, *Calamites*, *Asterophyllites*, *Annularia*, *Sphenophyllum*, etc. The Jurassic, Cretaceous, Eocene and later Tertiary are well represented by organic remains.

24. *Manual of the Mineralogy of Great Britain and Ireland*; by Robert Philips Greg, F.G.S., and William G. Lettsom. 484 pages, 8vo, with 400 wood-cuts.—Great Britain is especially rich in ores and other minerals, and hence a treatise on British mineralogy has an interest far beyond that of most local works. The number of species described in this volume by Messrs. Greg and Lettsom is about 240. The authors appear to have elaborated the subject with care, both as to crystalline forms, and localities, and have introduced much information of economical interest. Mr. Greg has one of the best private collections of minerals in Great Britain; besides which, the authors have had access to various other cabinets. The chemical portions of the work were revised by Dr. Heddle of Edinburgh.

25. *The Geologist: a popular Monthly Magazine of Geology*; edited by S. J. Mackie, F.G.S., F.S.A. Vol. I, commencing with January, 1858. Each number 48 pages, 8vo. London. 1*s*. per number.—This new Journal, while popular in its aim and tone, contains papers of scientific value.

26. *Mastodon on Long Island.*—Teeth and other bones of a Mastodon have been recently dug up near Jamaica, Long Island, at Beaseley's Pond, where an excavation for a water reservoir for the city of Brooklyn is in progress.

27. *Mineralogical Notes*; by W. J. Taylor.—Examining a collection of minerals from Chili, I find a specimen of *Bieberite* or cobalt vitriol, a species not hitherto reported from that region. It is from Tres Puntos near Copiapo.

A *native anhydrous sulphate of ammonia* occurs at the Pacific guano islands (Chincha). It is in rather hard lumps about the size of hickory nuts, and has a very fine crystalline structure, a yellowish white color, bitter taste and pungent odor.

Heteromorphite occurs at Chonta, Peru, associated with pyrites and quartz. In the specimen, in which I have detected it, it is mostly in the form of "cob-webs;" some crystals are a sixteenth of an inch long. The specimens were labelled "antimonial silver."

Enargite has been distinguished by Mr. Taylor among minerals from New Granada, and he has published on the subject in the Proceedings Acad. Nat. Sci. Philad. 1857, 168. We defer a further notice till our next Supplement.

III. BOTANY AND ZOOLOGY.

1. *Illustrations of the Genus Carex;* by FRANCIS BOOTT, M.D., Treasurer and Vice President of the Linnæan Society. London, W. Pamplin, 1858: folio.—This vast genus has been a favorite study with American botanists ever since, almost forty years ago, the venerable Professor Dewey commenced the publication in this Journal of his extended *Caricography*, and Schweinitz, the preparation of the *Monograph of N. American Carices*, which, edited and extended by Dr. Torrey, made its appearance in the year 1824. Dr. Boott, whom we claim as one of *our* botanists, notwithstanding his long residence in London, has sedulously investigated this genus for twenty years, beginning with the British American species, which he elaborated for Sir Wm. Hooker's *Flora Boreali-Americana*. The imposing volume before us, with 200 folio plates, comprises a portion only of the results of his continued study of Carex, and forms what we presume may be regarded as only the first part of an illustrated monograph of the genus, which for the number, fullness and faithfulness of the figures, and the magnificent scale of the work, is altogether unrivalled. For, although this volume holds out no intimation of a successor, neither the materials nor the patience of the disinterested author are exhausted, and illustrations for a second volume as large as the first, are, as we believe, nearly ready for the engraver.

One reason for the predilection for our North American species which this volume indicates, and which renders the work so invaluable to the botanists of this country, is given in the brief preface, or rather letter which follows the dedication of the volume to the author's early friend John Amory Lowell, Esq., of Boston; in which he writes:

"My original design in this work was limited to the illustration of the *Carices* of North America, which I had studied for several years under the advantage of frequent communication with my friend Mr. Carey, who had so ably described and grouped them in Dr. Gray's *Manual of the Botany of the Northern States;* and the lithographed impressions were made in the prosecution of that design. The extensive and beautiful collection of specimens subsequently brought by Dr. Hooker from the East Indies, which were liberally placed in my hands by that eminent man, impelled me to extend my plan; and I have endeavored to illustrate the genus at large."

Accordingly most of the species here figured, are North American or East Indian. It will be useful to enumerate the North American Carices here illustrated. They are:

C. filifolia, Nutt.
comosa, Boott,
utriculata, Boott,
Tuckermani, Boott,
Olneyi, (n. sp.) Boott,
Baltzellii, Chapm.
Boottiana, Benth.
marcida, Boott,
Hoodii, Boott,
exilis, Dewey,
C. amplifolia, Boott,
crinita, Lam.
gynandra, Schw. (*C. crinita*, var. Schw. & Torr.)
Houghtonii, Torr.
siccata, Dewey,
Liddoni. Boott,
arida, Schw. & Torr.
decomposita, Muhl.
Torreyi, Tuckerm.

C. alveata, Boott,
polymorpha, Muhl.
dasycarpa, Muhl.
aristata, R. Br. (*C. mirata*, Dewey).
tenax, Chapm.
pubescens, Muhl.
oligosperma, Michx.
Raeana, Boott.
Crus-corvi, Shuttlw.
festiva, Dewey,
alopecoidea, Tuckerm.
macrocephala, Willd.
Deweyana, Schw.
Parryana (incl. *Arctica*,) Dewey,
monile, Tuckerm.
virescens, Muhl.
trisperma, Dewey,
aurea, Nutt.
lenticularis, Michx.
longirostris, Torr.
Cherokeensis, Schw., (incl. *C. Christyana*, Boott),
flexilis, Rudge,
Crawei, Dewey,
conoidea, Schk.
Meadii, Dewey,
tetanica, Schk.
granularis, Muhl.
grisea, Wahl.
flaccosperma, Dewey,
laxiflora, Lam. & vars., (*C. anceps*, *C. blanda*, &c.).
plantaginea, Lam.
Careyana, Torr.
platyphylla, Carey,
retrocurva, Dewey,
digitalis, Willd.
oligocarpa, Schk.
Hitchcockiana, Dewey,
C. Willdenovii, Schk.
Steudelii, Kunth,
Backii, Boott,
Geyeri, Boott,
concinna, R. Br.
synchnocephala, Carey,
tenella, Schk.
triceps, Michx.
lanuginosa, Michx.
vestita, Willd.
filiformis, L.
Sullivantii, Boott,
venusta, Dewey,
arctata, Boott,
formosa, Dewey,
oxylepis, Torr.
Davisii, Torr.
æstivalis, Curtis,
gracillima, Schw.
sterilis, Willd.
stellulata, Good., var. *scirpoides*,
striata, Michx.
trichocarpa, Muhl.
intumescens, Rudge,
Grayi, Carey,
lupulina, Muhl.
lupiniformis, Sartwell,
gigantea, Rudge,
hystricina, Muhl.
torta, Boott,
decidua, Boott,
cryptocarpa, Meyer,
ambusta, Boott,
verticillata, Boott. [non Zoll. & Mor.]
Barrattii, Torr. (*C. flacca*, Carey, &c.),
ustulata, Wahl.
eburnea, Boott,
miliaris, Michx.

This ample list will be found to comprise a very large share of the Carices of Gray's Manual, as well as of the North American species of higher northern, more southern, and western regions. The view of these truthful figures brings back a lively remembrance of our former studies and collections of these fascinating plants, with no such volume as this to help us.

If, in questionable cases, our author is disposed rather to separate specifically than to combine, he has in this pursued the wiser and the more useful course, considering the nature of the present work, in which the main object is to give accurate representations of all the known Carices.

So the absence of any classification of the species is no disparagement here, assuredly expecting, however, that in due time, Dr. Boott will propound his matured views respecting the natural arrangement of the genus *Carex*. A. G.

2. *Journal of the Proceedings of the Linnæan Society, Botany*, Vol. II, No. 7, (1858).—Professor Henslow contributes a brief but interesting paper, On a Monstrous development in *Habenaria chlorantha*, which is thought to elucidate the morphology of the androecium.

Dr. A. Gray has an article, On the structure of the ovule and seed-coats of *Magnolia*,—illustrated by wood-cuts; which represent the growth of the ovule, its structure at the time of flowering, and the subsequent changes through which the primitive or outer coat of the ovule becomes *drupaceous* in the seed, its principal thickness thus forming the fleshy coat, while a growth of its inner stratum gives rise to the bony coat of the seed.

This was briefly shown in Hooker's Journal of Botany for 1855–6. The results of new observations are here detailed, and illustrated by truthful sketches. The observations which this paper simply records have recently been again disputed by Mr. Miers (in Ann. and Mag. Nat. Hist., for April last), who undertakes to demonstrate *a priori* that they cannot possibly represent the true state of the case. It suffices to reply: first, in the language of a distinguished investigator, that, leaving philosophers to determine what is and what is not possible, the business of the naturalist is to ascertain what is real; and that which is really so will always be possible, in spite of all contradiction. And, secondly, that the argument in this case, after all, is *not* "as convincing as any demonstration in Euclid;" because the six formal premises (i. e., whatever in them bears directly upon the point), from which the four inferences (called "axioms") were deduced, are not conceded. We refer particularly to the sixth premise, upon which the whole question turns; its statements appear not to accord with the obvious facts of the case in the anatropal ovule.

The remaining articles are:—Notes of a Botanical Ramble in the North of Spain, by Joseph Wood, Esq. Note on the Genus *Hemigymnia* of Griffith, by Dr. Thomas Thomson; showing that what Griffith took for a new Verbenaceous type is merely a *Cordia*. Note on some Suprasoriferous Ferns, by Thomas Moore, Esq., especially in a Fern with normally margined fructification allied to *Deparia*. Description of a remarkable spike or bunch of fruits of the Fig-Banana, producing two forms of fruit from the same inflorescence. On four Varieties of British Plants, by John Hogg, Esq.; and a part of Dr. F. Müller's Botanical Report on the North-Australian Expedition under the command of Mr. Gregory.

Thankful for what we have, we could still wish that the resources of the Linnæan Society were such as to enable it to publish more than it does, especially of rather extensive papers upon systematic botany, such, for instance, as Bentham's *Loganiaceæ*, and Hooker and Thomson's *Præcursores* of the Indian Flora. A. G.

3. *A list of the Orchidaceous Plants collected in the East of Cuba, by Mr. C. Wright, with Characters of the New Species*, by Prof. LINDLEY, (from *Ann. and Mag. Nat. Hist.*, May, 1838).—It appears that of the 80 species of Orchids gathered by Mr. Wright in his recent visit to Cuba, 21 are novelties (here characterized by Prof. Lindley), and several others

have scarcely been seen since the time of Swartz;—showing "how rich in new species of the Order is the vegetation of that little-known island, and how much is still open to discovery by the diligent traveller." A. G.

4. *Salices Boreali-Americanæ: a Synopsis of North American Willows;* by N. J. ANDERSSON, Professor of Botany in the University of Stockholm, Sweden.—In the March number of the Journal we stated that Prof. Andersson had undertaken to elaborate the *Salicineæ* for De-Candolle's Prodromus, and that materials in the form of complete specimens of Willows were earnestly solicited from every part of this country, in order that he may attain to something like the same full acquaintance with our species which he possesses of the European forms. We are happy to announce that Prof: Andersson has already made a preliminary study of our Willows, from such materials as he has been able thus far to examine; and that he has embodied the results in a memoir upon the subject, which is just printed in the Proceedings of the American Academy of Arts and Sciences, vol. iv, where it occupies thirty-two pages. The introduction and the conclusion, embracing a critical comparison of our Salices with those of Europe, are written by Professor Andersson in the English language (which he uses with remarkable facility); the descriptive and critical matter is in Latin. To render it accessible to all who take an interest in the subject, a small separate edition has been printed, and is sold by Messrs. B. Westermann & Co., No. 290 Broadway, New York. On the receipt by the Messrs. Westermann, or by the writer of this notice, of postage stamps to the amount of 36 cents, a copy will be sent by mail, prepaid, to any applicant. A. G.

5. *Systematische Untersuchungen über die Vegetation der Karaiben, in besondere der Insel Guadeloupe;* von A. GRISEBACH, (from Trans. Roy. Soc. Sci. Göttingen; vol. xvii, 1857), pp. 138, 4to.—This sketch of the Flora of Guadaloupe is very interesting and useful in itself, and of good promise for the *Flora of the British West Indies*, upon which Prof. Grisebach is now engaged, and which is so greatly needed. A. G.

6. *Essai d'une Exposition Systématique de la Famille des Characées;* par feu J. WALLMAN. *Traduit du Suedois;* par M. le Dr. W. NYLANDER. Bordeaux, 1856, pp. 91, 8vo.—This monograph of the *Characeæ* appeared in the Transactions of the Royal Academy of Sciences of Stockholm for 1852, published in 1854, a year after the death of the author, who barely lived to complete the manuscript. To render the mongraph more generally accessible, M. Durien de Maisonneuve engaged Dr. Nylander, the lichenologist, a compatriot of the author, to translate the memoir from Swedish into French, and caused it to be reproduced in this form in the Transactions of the Linnæan Society of Bordeaux, in the first volume of the third series, 1856, also publishing a small extra impression in a pamphlet form. The author characterizes no less than fifty species of *Nitella*, and sixty-six of *Chara*. A. G.

7. *Elogio di Filippo Barker Webb, scritto da* FILIPPO PARLATORE. Firenze, 1856, 4to, pp. 113.—The late Mr. Webb, a celebrated English botanist long resident in Paris, bequeathed his vast herbarium and excellent library to the Grand Duke of Tuscany, along with some funds for the care and augmentation of the collection. The immediate charge of collection was of course entrusted to Prof. Parlatore, a near friend of the

testator, and a most zealous botanist. After coming into possession of this noble bequest, upon the occasion of opening his course of lectures for the year 1855, Professor Parlatore pronounced the eulogy here published. It is illustrated by interesting explanatory notes, and followed by a catalogue of the works and opuscula published by Mr. Webb, twenty-four in number; by an account of his library and herbaria; and by selections from his correspondence with various botanists. The lithographed portrait in the frontispiece is a truer likeness of Mr. Webb than that which was published in his great work, the *Histoire Naturelle des Iles Canaries.* A. G.

8. *Agricultural Botany in the Western States.*—In the fourth volume of the Transactions of the State Agricultural Society of Wisconsin for 1854–7, Mr. Lapham has given a good popular account of the forest trees indigenous to that State, illustrated by outline wood-cuts. To the Transactions of the Illinois Agricultural Society for 1856–7 the same indefatigable author has contributed, 1. A Catalogue of the Plants of Illinois, prefaced by some historical and statistical details; 2. An account of the Native, Naturalized and Cultivated Grasses of Illinois, illustrated by three plates or pages of wood cuts. These do not equal the figures in Mr. Lapham's Grasses of Wisconsin. We are disposed to doubt the statement on p. 559 about the difference in the specific gravity of the pollen of Indian corn and of wild rice, unless the author can vouch for it from his own proper observations. Perhaps it rests upon no better basis of fact than the statement on the preceding page, that "had the wheat crop been at any time entirely destroyed, this invaluable grain would have been restored to us from seeds preserved for more than three thousand years in the folds of an Egyptian mummy!" We ought perhaps to say, that the asserted cases of such germination will not bear examination; and that those best qualified to judge utterly disbelieve, not only the asserted fact, but also the possibility of any such occurrence.

A. G.

9. *How Plants Grow: A simple Introduction to Structural Botany; with a Popular Flora, or an arrangement and description af Common Plants, both wild and cultivated;* by Asa Gray, M.D., Fisher Professor of Natural History in Harvard University. 234 pp., 16mo, illustrated by 500 wood engravings. New York, 1858. Ivison & Phinney.—Dr. Gray has prepared this little volume expressly for young beginners in botany, and for use in common schools, and has well carried out his purpose. The work is simple in style, and beautiful in its illustrations. While teaching with clearness the details of the subject, it is constantly bearing the mind, by simple explanations, above these details to higher thoughts and principles, and preparing it for the fuller survey of the science in the more extended works of the author's series. He considers in order —1st, How plants grow, and what their parts or organs are; 2d, How plants are propagated or multiplied in number; 3d, Why plants grow; what they are made for and what they do; 4th, How plants are classified, named and studied. Then, in the second part, the work contains a "Popular Flora for Beginners," including descriptions of the common plants of the country, both those of the woods and fields, as well as those of our yards and gardens. It is arranged according to the natural sys-

tem, and for the beginner in the science takes the place of the large Manual of Botany. The excellence of the volume consists in its being really "science made easy"—not by culling out "interesting facts" to attract, and tying them artfully together, but by presenting the *system of fundamental truths* in a manner intelligible and attractive to the young mind.

10. *The animals of Millepora are Hydroid Acalephs and not Polyps;* by Prof. Agassiz, (from recent letters to J. D. Dana).—"I have seen in the Tortugas something very unexpected. Millepora is not an Actinoid polyp, but a genuine Hydroid, closely allied to Hydractinia. This seems to carry the whole group of Favositidæ over to the Acalephs, and displays a beautiful array of this class from the Silurian to this day."

The drawings of Professor Agassiz which have been sent us for examination, are so obviously Hydractiniæ in most of their characters that no one can question the relation. With regard to the reference of *all* the Favositidæ (a group including Favosites, Favistella, Pocillopora, etc., as well as the minuter Millepora, Chætetes, etc.) to the Acaleph class, direct evidence is not yet complete, as the animal of the Pocillopora has not been figured by any author on zoophytes.* On this point Professor Agassiz observes in a subsequent letter, after observing that the Sideroporæ obviously are polyps:

"There are two types of radiating lamellæ, which are not homologous. In true Polyps (excluding Favositidæ as Hydroids), the lamellæ extend from the outer body wall inward, along the whole height of that wall, and the transverse partitions reach only from one lamella to the other, so that there is no continuity between them, while the radiating lamellæ are continuous from top to bottom in each cell. In Milleporidæ the partitions are transverse and continuous across the cells and so are they in Pocillopora and in all Tabulata and Rugosa, while the radiating lamellæ, where they exist, as in Pocillopora and many other Favositidæ, rise from these horizontal floors and do not extend through the transverse partitions; indeed they are limited within the spaces of two successive floors, or to the upper surface of the last. A careful comparison of the corallum of Millepora and Pocillopora with that of Hydractinia has satisfied me that these radiating partitions of the Favositidæ far from being productions of the body-wall are foot secretions, to be compared to the axis of the Gorgonia, Corallium, etc., and their seeming radiating lamellæ to the vertical grooves or keels upon the surface of the latter, which, reduced to a horizontal projection, would also make the impression of radiating lamellæ in the foot of the Polyp. If this be so, you see at once that the apparent radiating lamellæ of the Favositidæ do no longer indicate an affinity with the true Polyps, but simply a peculiar mode of growth of the corallum; and of these we have already several types, that of Actinoids, that of Halcyonoids, that of Bryozoa, that of Millepora and other

* From the specimens of the species of this genus which I procured in the Pacific I never obtained a clear view of the polyps, and hence made no figure. The brief description on page 523 of my Report, may be reasonably doubted until confirmed by new researches. The much larger size of the cells in Pocillopora, Favosites and Favistella than in Millepora, and the frequently distinct rays in these cells, are the characters I had mentioned to Prof. Agassiz as suggesting a doubt as to their being Acalephs, and to this what follows above relates.—J. D. D.

Corallines, to which we now add that of the Hydroids. Considering the subject in this light, is there any further objection to uniting all the Favositidæ with the Hydroids,—Sideropora and Alveopora being of course removed from the Favositidæ. It is a point of great importance in a geological point of view, and for years I have been anticipating some such result, as you may see by comparing my remarks in the Amer. Journal, May, 1854, p. 315. If all the Tabulata and Rugosa are Hydroids, as I believe them to be, the class of Acalephs is no longer an exception to the simultaneous appearance of all the types of Radiata in the lowest fossiliferous formations and the peculiar characters which these old Hydroid corals present appears in a new and very instructive aspect."

11. *Prodromus Descriptionis Animalium Evertebratorum, etc. Invertebrate species from the North Pacific;* by W. Stimpson. Parts III and IV. 16 pp., 8vo. From the Proceedings of the Academy of Natural Sciences, December, 1857, and March, 1858.—In this pamphlet, Mr. Stimpson notices in brief, the species of Maioid, Cancroid and Corystoid Crustacea obtained by him in his most fruitful North Pacific investigations. In all there are 136 species; of which, 18 of the species of Maioids, 32 of the Cancroids, and 1 of the Corystoids, are new. Among them, there are the following new genera: *Micropisa* and *Achæopsis* among Maioids, and *Lachnopodus*, *Sphærozius* and *Heteropanope* among Cancroids.

Part V has also appeared in the Proceedings Acad. Nat. Sci. Philad., 1858, p. 93—110. It takes up the Grapsoids and enumerates 108 species, of which 44 are described as new. The new genera instituted are: Family Carcinoplacidæ, *Pilumnoplax*, *Heteroplax;* Family Rhizopidæ, (related to *Gonoplacidæ*, but *eyes immoveable*, &c.), *Scalopidia*, *Rhizopa*, *Typhlocarcinus*, *Ceratoplax;* Fam. Macrophthalmidæ, *Chænostoma*, *Ilyoplax;* Fam. Dotillidæ, related to *Doto* of De Haan, which generic name is changed to *Dotilla* on the ground of its being preoccupied; Fam. Thelphusidæ, *Geothelphusa;* Fam. Grapsidæ, *Ptychognathus*, *Acmæopleura;* Fam. (new) Camptandridæ, *Camptandrum;* Fam. Asthenognathidæ (new), *Asthenognathus;* Fam. Hymenosomidæ, *Rhynchoplax.*

12. *Icones Zootomicæ* mit Originalbeiträgen der Herren G. J. Allman, C. Gegenbaur, Th. H. Huxley, Alb. Kölliker, H. Müller, M. S. Schultze, C. Th. E. von Siebold und F. Stein, herausgegeben von Julius Victor Carus, Prof. der vergleichenden Anatomie in Leipzig. Erste Hälfte oder Tafel I–XXIII, *Die Wirbellosen Thiere.* Leipzig, 1857. Verlag von Wilhelm Engelmann,—The *Icones Zootomicæ* of Prof. Carus are representations of the various tribes of the Animal Kingdom as to their details of anatomical structure in a series of large folio plates. The author commences with the Protozoa (Gregarinæ, Ciliata or Infusoria, Rhizopoda); the Radiates follow in order, then the Articulates, and then the Molluscs. The second half of the work, including plates 24 to 44, and illustrating the Vertebrata, is promised to appear in the course of the year 1858. The plates are executed with care and beauty, and each is accompanied with a leaf of explanations. The work is well adapted for the student in zoology, and we could wish that the plates might be issued also with English text. The internal anatomy of the various groups is elabo-

rately represented, and the student has but to turn over from plate to plate to gain an insight into the whole range of animal organisms. In general the work gives the results of the most recent investigations. Its system of classification, however, has not met with favor among zoologists.

13. *General Report upon the Zoology of the several Pacific Railroad Routes.* Part I. *Mammals.* By SPENCER F. BAIRD. 1 vol. 4to. Washington, 1857. We cite the following notice of Prof. Baird's great work from the Annals and Mag. Nat. Hist., May, 1858.

"The contributions already made to our knowledge of the Fauna of North America by the zoological appendices to the Reports of various Surveys and Explorations ordered by the government of the United States, are neither few nor unimportant. The accounts of expeditions to the Red River of Louisiana, the Great Salt Lake of Utah, and the Zuñi and Colorado Rivers, all contain materials worthy of much attention, and especially calculated to throw light upon the theory of the distribution of animal life in the North American continent. And in the Reports of the recent U. S. Astronomical Survey in the southern hemisphere, and of Commodore Perry's Japan expedition, we have evidence that the American government is sufficiently 'catholic' in its promotion of scientific investigation not to refuse assistance in extending our knowledge of the zoology of other parts of the world besides those immediately subject to its sway.

The seventh volume of the 'Reports of Explorations and Surveys to ascertain the most practicable and economical route for a Railroad from the Mississippi to the Pacific Ocean, made under the direction of the Secretary of War in 1853–56,' the title of the first part of which is given above, promises to bring still greater additions to our knowledge of North American zoology than any of the previous publications. This first part embraces only the *Mammalia;* but if the Birds, Reptiles, Amphibians, Fishes, and other orders of organized beings, are treated of in the same way, the result will be a complete and very interesting *résumé* of the zoology of this portion of the globe. The numerous different surveying parties which were employed on the proposed Pacific railway routes, amassed a very large quantity of materials for scientific research, which were all transferred by the U. S. Government to the guardianship of the Smithsonian Institution at Washington. The energetic Assistant Secretary of that establishment, Professor Baird—than whom no one could be found better qualified for the task—has himself undertaken to work out the specimens of Mammalia collected. The same gentleman, together with Mr. Cassin, the well-known ornithologist, will take the Birds. The Reptiles will probably be assigned to Prof. Girard or Dr. Hallowell, and the other orders to the naturalists best qualified to deal with them. This is an excellent method—putting the "right man in the right place," instead of setting a man learned in one 'ology to work at another, according to a plan which we have before now seen adopted in this country.

The present volume, which is the first of the series, and is entirely from the pen of Professor Baird, gives a general account of all the species of Mammals collected by the various aforesaid expeditions, noticing at the same time, in their proper places, all those known to inhabit the continent

of North America. It contains the technical descriptions of the families, genera, and species, remarks necessary to show their places in the system, their synonymy, and "an enumeration of all the different specimens collected." Other volumes will be devoted to the zoology of the separate expeditions, and enter more into particulars concerning habits, manners, &c. We beg to call particular attention to the plan of stating the exact locality of every specimen collected, here adopted, which is most useful for working out the theory of geographical distribution,—a subject now attracting so much attention.

"The time is now passed," says a recent distinguished writer on natural history, "when the mere indication of the continent whence an animal had been obtained could satisfy our curiosity; and the naturalists who have an opportunity of ascertaining closely the particular circumstances under which the animals they describe are placed in their natural home, are guilty of a gross disregard to the interests of science when they neglect to relate them. Our knowledge of the geographical distribution of animals would be far more extensive and precise than it is now, but for this neglect; *every new fact relating to the geographical distribution of well-known species is as important to science as the discovery of a new species.*"

To this volume there are likewise attached indices of the particular localities mentioned, of the authorities referred to, of local names and of scientific names,—all most useful and valuable appendages to the work.

The total number of species of Mammalia now recognized by Professor Baird as inhabiting the North American continent amounts to 220, of which he has himself examined specimens, whilst there are 35 others more or less doubtful. This is a vast increase,—no less than 70 species having been added as new to Audubon and Bachman's list, the greater part being the result of these expeditions. This, too, is exclusive of *Cetacea*, *Pinnipedes*, and *Bats*, none of which are touched upon in the present treatise. The first two of these groups can hardly be said to belong to the land-fauna of North America; but we must allow something for the *Chiroptera*, to arrive at the true number of North American Mammalia. Major John Leconte in his paper in the seventh volume of the 'Proceedings of the Academy of Natural Sciences of Philadelphia,' which is, we believe, the only modern authority on North American Bats, mentions fifteen species only as recognized by himself. This, however, raises the number of positively recognized Mammalia belonging to the North American fauna to 235, excluding Pinnipeds and Cetaceans.

Taking the several groups in the order in which they stand in Professor Baird's arrangement, we have first the *Insectivora*, containing Shrews and Moles,—together 26 species. Among these is a very remarkable (if reliable) addition to the American fauna in the shape of a second species of *Urotrichus*, a genus of *Talpidæ* hitherto embracing but one member, found in Japan. We may, however, notice the fact that but one imperfect specimen of this animal appears as yet to have been obtained; and an accurate comparison of it with the Japanese *Urotrichus* is requisite, before animals coming from localities so different can be recognized without doubt as the two only members of the same peculiar genus.

Of the *Carnivora* the large number of 46 are recognized as North American, made up of 9 *Felidæ*, 8 *Canidæ*, the *Bassaris astuta* of Mex-

ico and Texas—sole representative of the family *Viverridæ*, 23 *Mustelidæ*, and 5 species of *Ursidæ*. This is exclusive of several species established by previous writers, but which Prof. Baird has, with much judgment, reduced to the rank of local varieties—such as the *Canis nubilus* of Say, and the *Felis maculata* of Horsfield and Vigors.

The *Marsupialia* in the northern portion of the American continent are represented by two species of the genus *Didelphis*, commonly known as 'Opossums.'

The Rodents are, again, extremely numerous. In the first place, the Squirrels of different genera, with the Marmots (so called), Prairie-dogs, and Beavers, make up no less than 41 members of the family *Sciuridæ*. The *Saccomyidæ*, or Pouched Mice, which, in accordance with Mr. Waterhouse's views, but in opposition to those of Professor Brandt, are grouped together, next follow, and are considered by Professor Baird as "one of the most natural families of Rodentia, although the component genera have been widely separated by different authors. In the external cheek-pouches," he remarks, "there is no other family which exhibits any approach to it. These open outside of the mouth, and are of variable depth and lined with short hairs to the bottom. When inverted and dried, they look like sacs on each side of the head." Of these peculiar animals, the range of which is confined to Northern America and the Antilles, 21 species are enumerated, as appertinent to the fauna of the United States. Two Porcupines of the North American form *Erethizon* are the only *Hystricidæ* met with in this part of the world; but there are no less than 52 *Muridæ* of varied forms; and 13 Hares and Rabbits, with a single *Lagomys*, give 14 species of the family *Leporidæ*. Altogether, therefore, the order Rodentia in North America, as elsewhere, plays a most important part as regards numbers, embracing 130 species —more than half the whole number of Mammals known to occur.

The order *Edentata* is represented within the limits of the United States by a single straggling species of Armadillo, which occurs within the confines of Texas, and is somewhat doubtfully referred to the *Dasypus novem-cinctus* of Linnæus.

The Pachyderms have also but a single representative, the Collared Peccary, *Dicotyles torquatus*, which, it is remarked, "has a much wider range in North America than is supposed by European systematic writers. It not only occurs through Mexico, but even as far north in the United States as the Red River of Arkansas, in latitude 34°."

The Ruminants, however, muster more strongly, being better adapted for residence in the temperate regions of the North. In the first place, we have the Moose, *Alce Americana*. Then two species of Reindeer are admitted under the titles *Rangifer Caribou* and *R. Grœnlandicus*, though it is allowed that their distinctness is questionable. It is highly desirable that accurate investigations should be made as to the difference of these animals *inter se*, and with the European *R. Tarandus*, which is said to present somewhat corresponding variations. The genus *Cervus* and its subdivisions are represented by no less than six species, which are said to be all truly different, although the distinctions between *Cervus Virginianus* and *C. leucurus*, and *C. macrotus* and *C. Columbianus* require some further elucidation. North America contains only two Antelopes, the 'Prong horn' (*Antilocapra Americana*), and the so-called 'Mountain-goat'

(*Haplocerus montanus*), and a single sheep, the well-known Big-horn of the Rocky Mountains, *Ovis montana*. The Musk-ox of the Arctic regions (which, however, does not occur within the limits of the United States), and the Buffalo, *Bison Americanus*, conclude the catalogue of North American Ruminants, making up a total of 14 animals of this order. What a contrast in this respect does North America present to Africa, where more than 60 species of Antelopes alone are already known to occur, and the list is daily increasing! For, though we may laugh at Buffon's theory as to the animals of America being merely degraded forms of those of the Old World, there can be no question that the 'Great Continent' is far more productive of animal forms of a more highly organized structure, and of a nature more adapted to meet the various wants of mankind.

Table of Genera of North American Mammalia, according to Prof. Baird.

[The first column of figures gives the number of species examined by Prof. Baird himself, and the second, in brackets, those he has not examined.]

	Species.	
I. Rapacia.		
1. Soricidæ—		
1. Neosorex,	1	
2. Sorex,	12	[4]
3. Blarina,	7	
2. Talpidæ—		
4. Scalops,	4	[1]
5. Condylura,	1	
6. Urotrichus,	1	
3. Felidæ—		
7. Felis,	5	
8. Lynx,	4	
4. Canidæ—		
9. Canis,	2	
10. Vulpes,	6	
5. Viverridæ—		
11. Bassaris,	1	
6. Mustelidæ—		
12. Mustela,	2	
13. Putorius,	10	[1]
14. Gulo,	1	
15. Lutra,	2	
16. Enhydra,	1	
17. Mephitis,	5	[1]
18. Taxidea,	2	
7. Ursidæ—		
19. Procyon,	2	[1]
20. Ursus,	3	
II. Marsupiata.		
8. Didelphidæ—		
21. Didelphis,	2	
III. Rodentia.		
9. Sciuridæ—		
22. Sciurus,	12	[6]
23. Pteromys,	4	
24. Tamias,	4	
25. Spermophilus,	14	[1]
26. Cynomys,	2	
27. Arctomys,	2	[2]
28. Aplodontia,	1	
29. Castor,	1	
30. Castoroides,	1	
10. Saccomyidæ—		
31. Geomys,	5	
32. Thomomys,	7	[1]
33. Dipodomys,	3	[2]
34. Perognathus,	6	
11. Muridæ—		
35. Jaculus,	1	
36. Mus,	4	
37. Reithrodon,	4	[1]
38. Hesperomys,	15	[1]
39. Neotoma,	6	
40. Sigmodon,	2	
41. Arvicula,	16	[11]
42. Myodes,	3	
43. Fiber,	1	
12. Hystricidæ—		
44. Erethizon,	2	
13. Leporidæ—		
45. Lepus,	13	[2]
46. Lagomys,	1	
IV. Edentata.		
14. Effodientia—		
47. Dasypus,	1	
V. Pachydermata.		
15. Suidæ—		
48. Dicotyles,	1	
VI. Ruminantia.		
16. Cervidæ—		
49. Alce,	1	
50. Rangifer,	2	
51. Cervus,	6	
17. Cavicornia—		
52. Antilocapra,	1	
53. Aplocerus,	1	
54. Ovis,	1	
55. Ovibos,	1	
56. Bos,	1	
	220	[35]."

14. *On Species.*—In the article on Species, by J. D. DANA, in the number of this Journal for November last, (vol. xxiv,) there are the following typographical errors.—On page 313, 13th line from top, *equalities* should be *qualities;* and on the following page, 21st line from bottom, *propositions* should be *proportions.*

IV. ASTRONOMY.

1. *Fifty-Third Asteroid.*—This planet was discovered April 4, 1858, by Dr. Luther, at Bilk, and has been named *Calypso.* The fifty-second asteroid is called *Europa.*

2. *Third Comet of* 1858, (Gould's Astron. Journal, No. 113.)—The third comet of 1858 was discovered, May 2, 1858, by Mr. Horace Tuttle of the Harvard College Observatory, Cambridge, Mass.

3. *New Determination of the Solar Parallax,* (in a letter from Lieut. J. M. GILLISS to the Secretary of the Navy, dated Washington, Feb. 18, 1858.)—I have the honor to communicate to you the results of the observations specially made by the United States Naval Astronomical Expedition to determine the solar parallax—the sun's distance from the earth.

It will be remembered by the Department that Dr. Gerling—an eminent geometer of Germany—suggested the practicability of determining this fundamental astronomical datum from observations of Venus near the inferior conjunction, instead of awaiting the rare phenomenon of transits of the planet across the sun's disc; that an expedition to the southern hemisphere was proposed to the Department by myself for the purpose of making these observations, which, in connection with similar observations to be made at the Naval Observatory, would test the method; and that the earnest commendation of the measure by physicists, both in Europe and this country, induced Congress to authorize the expedition by special grants in the appropriation bills approved in 1848 and 1849.

We were absent from the United States nearly three and a half years, and the observations, constituting the more immediate object of the expedition, extended through parts of each of the years from November, 1849, to September, 1852, inclusive. So many classes of observations were embraced in the plan of operations adopted by the Department, that our small party was almost constantly occupied in observatory duty proper, and it was not possible to prepare any of the data for the final computations until after the return of the expedition to the United States. Then our first efforts were to put in proper form for the computer all the observations of the planets Venus and Mars, and the stars with which they had been compared. Whilst our men of science had been unanimous in advocating the organization of an expedition, because of the additional mass of important information certain to be collected by it, there were some who entertained an opinion that the method of determining the parallax proposed by Dr. Gerling would not afford a result as reliable as had been derived from the transits of Venus in 1761 and 1769. For obvious reasons, therefore, it was proper that the discussion of the results from our observations should be intrusted to an astronomer thoroughly competent to appreciate the problem, yet wholly uncommitted as to the comparative merits of the two methods.

Under the sanction of the Department, Dr. B. A. Gould, Jr., of Cambridge, Mass., was selected for the purpose; and the elaborate refinement

with which he has executed this difficult and delicate task, is ample evidence that the confidence of the Department was not misplaced. His report does him great honor. It will fill from 130 to 140 pages of volume third of the results of the expedition, the larger portion of it, and all the remainder of the volume, being already printed.

The result obtained by him for the Sun's Equatorial Horizontal Parallax is 8″·4950, or 0″·0762 less than the value commonly adopted, and he concludes that we may assume with advantage 8″·5000, corresponding to a distance from that luminary of 96,160,000 statute miles. As the information is of high interest to astronomers, I have the honor to suggest that it be made known in advance of the publication of the volume.

4. *Theory of the Motion of the Heavenly Bodies moving about the Sun in Conic Sections: a translation of Gauss's "Theoria Motus," with an Appendix;* by CHARLES HENRY DAVIS, Commander, United States Navy, Superintendent of the American Ephemeris and Nautical Almanac. Boston: Little, Brown & Co. 1857.—It appears from the translator's preface to this work that it is to the liberality of the Smithsonian Institution and the Navy Department, that we owe the first appearance of Gauss's immortal work in an English dress. By the authority of the Hon. J. C. Dobbin, Secretary of the Navy, the translation of Commander Davis has been printed by the joint contributions of the Nautical Almanac and the Smithsonian Institutions.

Although it must be a long time before Gauss's profound work can be superseded, yet since its publication in 1809, some improvements (not indeed very important) have been made, and certain parts of the method have received special development. To bring the work fully up to the time, therefore, Commander Davis has added an Appendix containing the results of the investigations of Professor Encke and Professor Peirce upon the exceptional case of a twofold determination of the orbit from the same three geocentric places; Prof. Peirce's Graphic Delineations, showing geometrically the roots of Gauss's Equation IV Article 141; a Table for the Motion in a Parabola from LeVerrier's *Annales de l'Observatoire Imperial de Paris;* Bessel's and Posselt's Tables for Ellipses and Hyperbolas closely resembling the Parabola; a convenient Table by Professor Hubbard for facilitating the use of Gauss's formulas for ellipses and hyperbolas, of which the excentricities are nearly equal to unity; and, in the form of notes on their appropriate articles, useful formulas by Bessel, Nicolai, Encke, Gauss and Peirce.

As to the subject matter, therefore, this publication leaves scarcely anything to be desired, and must prove a highly acceptable aid to the student of theoretical astronomy as well as to the practised computer.

The typographical execution of the work is also worthy of the classic original. We are also insured the greatest accuracy in the *formulas* of the body of the work by the careful supervision of Prof. Chauvenet, who (judging by the list published in the Astronomical Journal, No. 109) has probably left no erratum of the slightest importance uncorrected.

We wish we could speak as unreservedly in praise of Commander Davis's translation of the text. It is true that, with some exceptions, which we shall be compelled to notice presently, he has contrived to convey Gauss's meaning by a *verbatim* translation, which has at least the

merit of being very faithful and of taking no liberties with the original. Something more, however, was to be expected from a translator of Gauss. A faithful and indeed a literal translation need not be ungainly and stilted; certainly it can and should be purged of Latinisms. We are not obliged to write, "it is also, evidently, *allowable* to bring the same expression under the form," etc.,* simply because we happen to have in the original the words "reducere *licet.*" Nor is the Latin word "petitur" in the sentence "Methodus alia, problema art. praec. solvendi, ex aequationibus $\cos\varepsilon \sin l =$ &c., *petitur* ;" gracefully or even correctly rendered by "is required" in the sentence "Another method *is required* of solving the problem of the preceding article from the equations $\cos\varepsilon \sin l =$ &c."† In Art. 70 Gauss says: "Sponte jam patet, omnes aequationes Art. 62 etiam hic locum esse habituras;" the translator says, "Now it is evident that all the equations of article 62 will be applicable to this place also;" a rendering that suggests the impossible idea that the translator thought *hic* and *locum* to agree in case!

These instances are, however, of very little importance, since an intelligent reader can perceive what was intended. But it is far different when the translation becomes unintelligible without a reference to the original. Thus we find in Art. 115, "But although, *from an indiscernible principle*, it is not to be expected that such a case" (the special case in which the plane of the orbit coincides with the ecliptic) "would ever actually present itself in nature," etc. Upon reading which we were seized with a strong desire to know what "an indiscernible principle" could be; but as the translation gave no clue, we turned to the original, where we were amazed to find the sentence to read thus: "Etiamsi vero *per principium indiscernibilium* haud exspectandum sit, talem casum in rerum natura umquam se oblaturum esse," etc. Can it be believed that a translator of Gauss should, even in a moment of forgetfulness or carelessness, imagine that the neuter genitive plural *indiscernibilium* agrees in case and number with the neuter accusative singular *principium?* And yet, how can we escape this conclusion, since it is evident that he has at last given up in despair of finding out what Gauss meant, and has written down what he thought was at least a *safe literal* translation! It is hardly necessary to tell the reader who has referred to the original, that in the phrase "by the principle of indiscriminate (things)," Gauss briefly sums up the argument that since the orbits fall in all positions *indiscriminately*, any one special position in an assumed plane, was not to be regarded as probable. We should have been well satisfied with the fidelity of the translator, if, instead of "by an indiscernible principle," he had given the (unavoidably) free translation, "from the fact that the orbits may fall in all positions indiscriminately."

We have marked a number of mistranslations (such at least in our judgment) quite as glaring as the above. We shall only stop to notice the following. In Art. 78, "fiet generaliter" is rendered "it may generally be done," when the meaning is certainly "it may be done in a general manner" (*always*). In Art. 81, "postquam angulus auxiliaris A per aequationem tang (A—etc.) determinatus est," is translated "afterwards the auxiliary angle A is determined by the equation tan (A—etc.);"

* Art. 58. † Art. 67.

when the meaning is, "after the angle A has been determined by, &c.;" as the translator would have known, even in his ignorance of Latin, if he had only understood the mathematics of the subject matter.

In Art. 88, we have, "Let the eccentric anomalies E, E', and the radii vectores r, r', correspond to two places of the true anomaly v, v', (of which v is first in time); the Latin being, "Respondeant duobis locis anomaliae verae v, v' (e quibus v sit tempore anterior), anomaliae excentricae E, E', radiique vectores r, r';" where it appears again that the translator forgot to consult his Latin grammar. He would have found that *anomaliae* here cannot be the genitive singular; but aside from this, there is no sense in the expression "two places of the true *anomaly* v, v'." It is clear, in short, that *anomaliae verae*, *anomaliae excentricae* and *radii vectores* are all in the same case, subjects of *respondeant*.

In Art. 98, there occurs in the original "*Pro p* enim adhiberi poterit vel aequatio 7 art. praesentis, vel aequ. 18, art. 95:" which, the slightest acquaintance with the equations referred to would have enabled the translator to see, means "*For p* (that is, for computing p) we may employ either equation 7 of the present article, or equation 18 Art. 95,"—but he has it, "*Instead* of p, either equation 7 of the present article, or equation 18 of article 95 might be employed." The impossibility of employing p instead of an equation (!) we should think would have led the translator to the discovery of his error, if indeed he was translating with any idea whatever of the sense of his author.

In Art. 71, we read, "The time $t-T$, within which the light traverses . . the mean distance of the earth from the sun which we take for unity, will be the product of the distance Pa into 493^s." Without any reference to the original, the blunder here is obvious. Remembering only that Pa is here the distance of a planet P from a point of observation a, the meaning is: "The time $t-T$ will be the product of the distance Pa into 493^s, within which (i. e. 493^s) light traverses the mean distance of the earth from the sun which (mean distance) we take for unity." Moreover this is the verbatim rendering of the original.

The last sentence of Art. 109 stands thus in the original: "In tali casu etiam ad solutionem problematis supra tractati, (art. 85—105) adhiberi possent: sed quoniam, nostro judicio, ne tunc quidem brevitatem solutionis supra traditae praebent, huic methodo fusius exponendae non immoramur." The subject of the verb *adhiberi possent* is here certain series just treated of in this article 109; and the plain meaning is that "In such a case they (these series) might also be employed for the solution of the problem treated of above (art. 85—105): but inasmuch as, in our opinion, they do not then afford the brevity of the solution above given (viz. in art. 85—105) we do not dwell more fully upon this method" (viz. upon the method by series.) Capt. Davis renders it thus: "In such a case, the methods previously discussed (art. 85—105) might be employed for the solution of the problem: but, as in our judgment, they do not furnish the brevity of the solution given above, we do not dwell upon the further explanation of this method," which is nothing but confusion, involving contradiction, and so far as it would convey any meaning to a merely English reader, would convey the opposite to what Gauss intended.

In Art. 157 there is another instance of the translator's misinterpretation of the meaning of the Latin word "pro," to say nothing of the ignorance it shows of the subject treated of. The Latin is: "In formulis art. 140 pro a, b et $\frac{b}{a}$ ipsos $\sin\delta$, $\sin\delta'$, $\sin\delta''$, retinere opertet, et perinde in formulis art. 142:" which means: "In the formulas of art. 140 for (computing) a, b and $\frac{b}{a}$, and also in the formulas of art. 142, $\sin\delta$, $\sin\delta'$, $\sin\delta''$, themselves, must be retained." But Capt. Davis says: "In the formulas of art. 140 $\sin\delta$, $\sin\delta'$, $\sin\delta''$ must be retained *instead of* a, b *and* $\frac{b}{a}$, and also in the formulas of Art. 142."

We could add instances of slight misapprehensions, which however would not arrest the reader. It is to be regretted that the translator was not as fortunate in obtaining some one to revise his text as he was in getting his formulas rectified. Nevertheless, the formulas being correct (even more correct than in the original) and the meaning of the text being in the majority of cases sufficiently apparent, this publication will be of great value to those students who are unable to read the Latin; and even to those acquainted with the original work, it will be a convenience to have the subjects comprising the Appendix of the translation brought together. Nor must we forget that to Capt. Davis we owe the appearance of the only translation that has been made.

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *Twelfth Meeting of the American Association for the Advancement of Science.*—The twelfth meeting of the American Association opened at Baltimore on Wednesday, the 28th of April last. On the absence of both the President and Vice President, Prof. Caswell, the presiding officer of the preceding year, took the Chair, and by vote, was subsequently requested to preside through the meeting. As the Spring is less favorable for a scientific gathering than the Summer, the number present was not quite as large as usual, and there was a corresponding effect on the scientific contributions. The Mayor, Maryland Institute, Historical Society, and many generous citizens of Baltimore, contributed liberally to the interests of the occasion.

The meeting adjourned on Tuesday, the 5th of May, to meet at Springfield, Massachusetts, on the first Wednesday of August, 1859. Professor Stephen Alexander of Princeton, was chosen President for the ensuing year, and Professor Edward Hitchcock of Amherst, Vice President.

The following is a list of the papers presented at the meeting:

I. *Astronomy, Physics, Mathematics.*

Researches in Analytic Morphology. Part First of a New Theory of Curves. By Benjamin Peirce.

Note on the Atlantic Cotidal Lines; derived from the Equilibrium Theory. By Benjamin Peirce.

The Tides of Saturn's Rings. Part I. By Benjamin Peirce.

Researches in Analytic Morphology. Supplement. By Benjamin Peirce.

Further Remarks on Systems of Coördinates in a Plane. By Thomas Hill.

On the Australian Instrument, called the Boomerang. By Joseph Lovering.

On a Supposed Personal Equation in Determining Latitudes, by Talcott's Method. By A. D. Bache.

On the Currents of New York Bay near Sandy Hook. By A. D. Bache.

Comparison of the Committee Metre of the American Philosophical Society, with other Standards. By A. D. Bache and J. E. Hilgard.

On the Results of Dr. Kane's Magnetic Observations in his Second Arctic Expedition. By A. D. Bache and Charles A. Schott.

On the Extinction of Light from Terrestrial Objects. By L. W. Meech.

On the Electrical Phenomena of certain Houses in New York. By Elias Loomis.

On the Electrical Phenomena of certain Houses in N. York. By Samuel St. John.

Note on Curvature. By William Watson.

On the Effect of Sound that is produced in different Stages of the Atmosphere. By A. B. Engstrom.

On the Dynamics of Ocean Currents. By E. B. Hunt.

On Anomalies in the Florida Gulf Stream, and their further investigation. By E. B. Hunt.

On the Cause of the Rotation and Orbital Motion of Extensive Revolving Storms. By E. B. Hunt.

On the Mean Distances of the Periodic Comets. By Daniel Kirkwood.

On the Curve of Swiftest Descent. By Stephen Alexander.

Note on some Daguerreotype Impressions of the Sun's Image. By S. Alexander.

On the Harmonies of the Solar System. By Stephen Alexander.

On a Criterion applicable to the Question of the Common Origin of the Asteroids, and, possibly, also of certain Comets. By Stephen Alexander.

Observations made at the Falls of Niagara, Sept. 1st, 1857. By Joseph Henry.

On the Application of the Rotary Mirror to the Aneroid Barometer. By Joseph Saxton.

Note on Oceanic Currents. By James D. Dana.

Some Experiments on Sonorous Flame, with Remarks on the Primary Source of the Vibrations. By William B. Rogers.

On Ring-Formations in Gases and Liquids. By William B. Rogers.

On Distribution; The Phyllotaxis Deduced from the Mathematical Definition of Distribution. By Chauncey Wright.

On Deep-Sea Soundings—Discussion Showing the Influence of the Resistance of the Water on the Sounding Weight and Line. By W. P. Trowbridge.

An Observation of the Sonorous Vibrations of Coal Gas Flames. By A. M. Mayer.

On the Pendulum, with a Description of an Electric Clock. By F. A. P. Barnard.

A Note in relation to Further Researches on the alleged Influence of Solar Light on the process of Combustion. By John LeConte.

II. *Meteorology.*

On the Geographical Distribution of the Places from which Meteorological Observations are reported to the Smithsonian Institution. By James H. Coffin, (in behalf of the Secretary of the Institution).

On the Currents of the Atmosphere. By James H. Coffin.

A paper in Advocacy of a great systematic chain of simultaneous Meteorological Observations throughout the whole of the American Continent. By R. Lachlan.

Winds and Rains of California. By H. G. Warner.

Report on Atmospheric Electricity—Part First. By Joseph Henry, Secretary of the Smithsonian Institution.

On the Meteorology of Mosul. By W. F. Williams.

On a supposed protracted Perturbation in the Atmospheric Pressure, in the Region of the White Mountains, by an Extensive Conflagration of Forests. By Arnold Guyot.

Note on Certain Iridescent Phenomena upon Lake Michigan. By Geo. W. Burnap.

Climate of North America. By J. B. Hurlburt.

III. *Geology, Geography.*

Rocks of Kansas. By G. C. Swallow.

Synopsis of the Ichnology of New England. By Edward Hitchcock.

Description of the Coal Beds near Fort Belknap, in Texas, with the subjacent and superincumbent Strata, and the discovery of Fusulina Limestone there, in a communication from Dr. Francis Moore to Edward Hitchcock.

Upon the Thickness of some Metamorphic Strata in Vermont and Massachusetts. By Charles H. Hitchcock.

Remains of the American Mastodon, found on Long Island, near New York. By J. C. Brevoort.

The Chemical Constitution of the Chatham Series, in the Valley of Deep River, in North Carolina. By E. Emmons.

On the True Elevation of the Culminating Points of the Appalachian System in the Black, the White and the Green Mountains. By Arnold Guyot.

Permian Rocks of Southern Illinois. By A. H. Worthen.

Observations upon the Genus Graptolithus and allied Genera. By James Hall.

Observations upon the Genus Meganteris and other Palæozoic Brachiopoda. By James Hall.

Formation and Age of Burlington Heights at Hamilton, Canada West. By J. B. Hurlburt.

On the Earthquake which occurred in Western New York and vicinity on the 23d of October, 1857. By Charles West.

On the General Features in the Configuration of the Bays, Sounds, Capes, Islands, &c. of the Eastern Coast of the United States, and on their Classification. By Dr. J. G. Kohl.

The Geological Map of Pennsylvania. By H. D. Rogers.

IV. *Chemistry, Mineralogy, Zoology.*

On the Theory of the Polyacid Bases. By Wolcott Gibbs.

Notice of New Bases, containing Metals and the Elements of Ammonia. By Wolcott Gibbs.

On the Preparation of some pure Sulphates, and particularly of Sulphate of Copper. By Henry Wurtz, of New York.

Some Chemical Examinations connected with a Bullet, imbedded for more than forty years in a Man's Lung. By Henry Wurtz.

Some Improvements in the preparation of hard minerals for Analysis. By Henry Wurtz.

Some Suggestions regarding new applications of Glycerine. By Henry Wurtz.

On modes of increasing the heat of the Mouth Blow-pipe, and some new Blow-pipe Manipulations. By Henry Wurtz.

Abstract of an Investigation on the action of hot Nitric Acid on the Metallic Chlorids, with a New Method for the separation of Magnesia from the Alkalies. By Henry Wurtz.

On the action of Nitric acid in the cold upon some Metallic Chlorids, with new modes of obtaining Pure Compounds of Barium, Strontium and Cadmium. By H. Wurtz.

On the Detection of Nitric acid, with observations on the action of Sesquisalts of Iron upon Indigo and Metallic Gold, and on the Neutralization of the Colors of Metallic Solutions; with some Experimental Illustrations. By Henry Wurtz.

Preliminary Notice of an Investigation upon the action of hot Chlorohydric Acid on the Metallic Nitrates. By Henry Wurtz.

On the Occurrence of Cobalt and Nickel in Gaston county, North Carolina. By Henry Wurtz.

On the Solubility of the Phosphates used in Agriculture, and their Assimilation by Plants. By A. Snowden Piggot.

On the Character, Natural Relations and Relative Rank of the Primary Divisions of the Vegetable Kingdom, founded on Differences of Structure; and especially on the true rank of the Class of Gymnosperms. By Arnold Guyot.

Marine Phosphorescence. By H. G. Warner.

Introductory Remarks to the Psychology of Animals. By D. F. Weinland.

Notice on the production of Heat by the Formation of Cells. By G. Habich,—communicated by D. F. Weinland.

Notice on two new Human Cestoda. By D. F. Weinland.

V. *Philology, Miscellaneous Papers.*

Analysis, Classification, and Representation of the Sounds of the English Spoken Alphabet. By Wm. D. Whitney.

Notice of an Arabic Work on Physical Science, of the Twelfth Century. By W. D. Whitney.

On the Insensible Gradation of Words in Comparative Philology; illustrated by five charts. By J. P. Lesley.

Signs of Significance—like Symbols for a Language—in Fanciful Rock-work—the Stone Spear and Arrow Heads of the Catawbas. By J. H. Gibbon.

Distinct Tones and Accents of Voice—with Special Signs—explain sensible emotions from Mute Animals to each other. By J. H. Gibbon.

Certain Identities between Dead Languages and Existing Alphabets. By J. H. Gibbon.

A Method suggested for Teaching Notes of Music to Negro Boys, not instructed to read. By J. H. Gibbon.

On Wethered's Application of Combined Steam. By C. E. Wethered.

Grape Culture in Missouri. By G. C. Swallow.

On the Establishment of a Mathematical Journal. By J. D. Runkle.

Observations upon the Practicability of reaching the North Pole. By Isaac I. Hayes.

Antiquities at Grave Creek—Inscribed Stone—Explorations at the West. By Dr. Wills De Hass.

Application of the Principles of Caloric to the construction of Warm Air-Furnaces. By James Bolton.

On the Confirmation, from Providence data, of a newly determined law of mortality for Early Childhood. By E. B. Elliott.

On some points of inquiry that may be properly introduced in the Federal Census. By Franklin B. Hough.

Concerning the number of Telegraphic Conductors that may connect with a single Battery, at an extreme station, without sensible interference. By E. B. Elliott.

On the Causes of the Variable Illuminating Power of Coal Gas. By W. E. A. Aiken.

On Recent Efforts to Deepen Maffit's Channel across the Bar of Charleston Harbor. By P. N. Lynch.

On the Telegraph aud the Telegraphic Lines of the World. By Lawrence Turnbull.

On the production of Local Anæsthesis, by a novel application of Current Electricity. By C. P. Williams.

On the Calculation of the Earth-work of Railroads, &c. By W. M. Gillespie.

2. *The Mathematical Monthly.*—Mr. J. D. Runkle of Cambridge, Mass., connected with the Nautical Almanac office at that place, has issued a Prospectus of a Mathematical Journal with the above title. It is to be handsomely printed in small quarto form, and issued in monthly numbers of at least twenty-four pages. Mr. Runkle expresses his idea of the proposed journal in his Circular as follows:

"It seems to us that such a journal is needed; one that shall embrace, among its contributors, the best talent, in order that younger laborers in the same field may always have before them a high standard of excellence, and that it may be a fair index of the mathematical ability of the country. On the other hand, however, care should be taken not to graduate it, as a whole, too high above the average attainments of mathematical students; otherwise, only the few would be interested in it or benefited by it. It should therefore embrace in its pages solutions, demonstrations, and discussions in all branches of the science, as well as in all its various applications.

"It should contain notes and queries, notices and reviews, of all the principal mathematical works issued in this country, as well as in Europe.

"In short, it should be the medium of all kinds of information pertaining to the science, to which a large proportion of our mathematical students have at present no ready access.

Mr. Runkle has also in view to issue prizes for prize problems and mathematical essays.

The Journal is one very much needed in the country, and should succeed. Its plan is ample and generous, and the known ability and energy of the editor will give it character and success, if the country will sustain him. Annual subscription per single copy $3,00.

3. *Proceedings of the American Pharmaceutical Association at its Sixth Annual Meeting, held in Philadelphia, Sept.* 1857. 8vo, pp. 178. —This session of the Association appears to have been more fully attended than previous ones, and quite fruitful of questions proposed for future investigation. Scientific reports were made on various important subjects, affording gratifying evidence of the zeal and ability of its members. Among these, that on the "Progress of Pharmacy" is very full, giving a comprehensive *resumé* of the improvements and discoveries in practical chemistry, pharmacy and materia-medica during the year.

That on "Improvements in methods of rendering medicinal preparations pleasing to the eye and to the taste, and agreeable to use," contains information of great practical importance to all dispensers of medicines, and if adopted by them would largely increase their trade, while contributing still more to the comfort of the sick. It has frequently been to us a matter of wonder that so little attention is paid to this subject by apothecaries generally, while every consideration of humanity, refinement and taste demands it.

A report on "Weights and Measures," one on "New England Isinglass," and another on the "Manufacture of Iodine from the ashes of sea-weeds," are valuable and compare favorably with reports of other scientific associations. A voluntary paper on "Ethical Analysis," by Edward Parrish, is an excellent *beginning* for a more extended article on the *ethics of the profession*—a subject which ought to be brought more fully and frequently under consideration. This must necessarily result however, in due time, from the efforts of the Association to elevate and advance the calling of the apothecary from the position of a mere trade to that of one of the professions—a dignity to which we hope soon to see it attain.

4. *Geographical Society of London.*—The Victoria medal of the Geographical Society has been awarded to Alexander Dallas Bache, Superintendent of the Coast Survey.

5. *Geological Society of London.*—The Wollaston medals of the present year have been conferred by the Geological Society of London on Hermann von Meyer of Frankfort-on-the-Maine, and Professor James Hall of Albany.

6. *Addendum to the article on the U. S. Coal Measures* (p.112).—According to E. T. Cox, coal bed No. 9 contains the fossils *Avicula recta-lateraria, A. acosta, Solenimya soleniformis, Nautilus decoratus, Productus muricatus, Nucula Hameri, Pleurotomaria Grayvillensis, Chonetes mesoloba, Productus equicostatus, Bellerophon carbonarius* (*B. Urii* of other American authors), etc. Bed No. 11, contains, *Loxonema regularis, L. Halli, Chemnitzia parva, Pleurot. Bonharborensis, P. depressa, Arca carbonaria, Gervillia longispina, Macrocheilus gracilis, Orthis resupinoides, Avicula*

rectilateraria, *Macrocheilus inhabilis*, *Productus muricatus* (rare), *P. Rogersi*, *P. equicostatus*, *Athyris subtilita*, *Spirifer Meusebachanus*, *Orthoceras* undetermined, etc.

7. Obituary.—Dr. James Deane of Greenfield, died on Wednesday, the 9th of June, at the age of 56. Dr. Deane is known to the geologists of the country by his papers on the Footprints of the Sandstone rocks of the Connecticut valley. The first specimens seen by Prof. Hitchcock were brought to him by Dr. Deane. Since then the subject has grown into one of great importance to American geology, and Dr. Deane has contributed his part to this result. For the year or two past he has been engaged upon a great work on these Footprints, illustrated by lithographs and photographs made by himself. His lithographed drawings were very numerous and exceedingly faithful and life-like, and it will be a great loss to science if they fail to be published. His photographs also were excellent. Among the most interesting are photographs of the insect tracks of the same rocks, which he had brought into comparison with recent tracks of water insects, by means of photographs of the latter also. There are others which have, as he thought, a strong Marsupial look. The series of illustrations which he has prepared, even if without text, would make a volume of great beauty and scientific value.

Erasmus D. North, M.D., formerly of New Haven, Ct., died at Westfield, Massachusetts, on the 17th of June, aged 51 years. Dr. North was one of the best amateur microscopists of the country, and contributed valuable papers to this Journal on the construction and improvement of microscopes. He was a man of extensive knowledge also in other departments of science. For many years he occupied with ability the post of Instructor of Elocution in Yale College, and in that time he published a work on the subject, displaying a thorough acquaintance with its principles and practice. He leaves behind an unfinished life of Percival, the poet and geologist; and a double loss has therefore befallen the country in his decease.

Dr. William Gregory, the distinguished Professor of Chemistry in the University of Edinburgh, died on Saturday evening, June 24, 1858. Dr. Gregory had suffered for many years from rheumatic seizures, and had been unable to lecture during the past winter session. He died in the prime of life, and has left behind him a widow and an only son.

Johannes Müller.—The University of Berlin has to bear a heavy loss. One of its most celebrated members, Prof. Johannes Müller, the physiologist, died suddenly of apoplexy, on the 28th of April, not quite fifty-seven years old. Müller was born at Coblenz, on the 14th of July, 1801, and had been living at Berlin ever since 1833.

Transactions of the Academy of Science at St. Louis. No. 2, of vol. I. 303 pp. 8vo, with plates. St. Louis, Missouri. Price $1.00.—This number of the Transactions of the Academy of Science at St. Louis is especially remarkable for the importance of its geological papers. We have already cited from several of them in this and our preceding volume. The contents are as follows:

B. F. Shumard, M.D.: Tertiary and Cretaceous fossils of Oregon and Washington Territories and Vancouver's Island.—T. C. Hilgard, M.D.: Exposition of a Natural Series by Intermediate Catholic Affinities in the Vegetable Kingdom.—G. C. Swallow: Grape Culture in Missouri.—A. Wislizenus, M.D.: Was Man Cotemporaneous with the Mastodon?—F. Hawn: The Trias of Kansas.—G. C. Swallow and F. Hawn: The Rocks of Kansas [see above, p. 115].—B. F. Shumard and G. C. Swallow: Descriptions of new Fossils from the Coal Measures of Missouri and Kansas.—H. A.

PROUT, M.D.: New species of Fossil Bryozoa (Genera, *Fenestella* and *Eschara* from the Carboniferous limestone of the Organ Mountains, New Mexico, and new genus *Fenestralia* from the upper layer of the St. Louis Limestone.)—B. F. SHUMARD: New species of Blastoidea, [see above, page 127].—G. SEYFARTH, D.D.: A remarkable seal in Dr. Abbot's Egyptian Museum, at New York.—H. A. PROUT: New Bryozoa from the Palæozoic rocks of the Western States and Territories.—G. G. SHUMARD: Geology of New Mexico.—G. G. SHUMARD: New Fossils from the Permian of New Mexico and Texas.—SPENCER SMITH: On the formation of Hail.—ENGLEMANN and WISLIZENUS: Meteorological Observations for 1857.

PROCEEDINGS ACAD. NAT. SCI. PHILADELPHIA, 1858.—p. 1, Note on Urnatella; *J. Leidy.*—p. 5, Catalogue and Notes of the Collection of Egyptian Antiquities in the Collection of the Academy; *J. H. Slack.*—p. 7, Niobrara Fossil Mammals; *J. Leidy.*—Mastodon Bones at the village of Tambla, Honduras, identical with M. giganteus; *J. L. LeConte.*—p. 8, On an Alga; *Ashmead.*—Letter from Meek and Hayden, dated Feb. 16, 1858, announcing the Permian in Kansas; *J. Leidy.*—p. 11, Two species of horse in the Post-pliocene of America, here named *E. fraternus* and *E. complicatus*; *J. Leidy.*—p. 12, Cast of a Mastodon tooth, bearing Harlan's label "*Mastodon longirostris, Miocene Maryland,*" recently found, and serving to identify the species so named by Harlan; *J. Leidy.*—Cast of a Tooth on which Harlan based his *Tapirus Mastodontoides* found, and sustaining the conclusion of Hayes and Cooper, that it was the milk molar of a Mastodon; *J. Leidy.*—p. 13, Unionidæ of Nebraska identical with those of Cincinnati; *I. Lea.*—p. 19, On an Optical Illusion; *A. Wilcocks.*—p. 20, Niobrara Mammals; *J. Leidy* [noticed in this number, p. 116].—p. 29. New Neuroptera, collected by the North Pacific Exploring Expedition; *P. R. Uhler,* —p. 31, New Crustacea, ibid.; *W. Stimpson* [noticed in this number, p. 141].—p. 40, New Unios from Tennessee, Alabama and North Carolina; *I. Lea.*—p. 41, New Helix and Planorbes; *I. Lea.*—p. 41, Rocks and Fossils of Nebraska; *Meek* and *Hayden* [noticed in this Journal, vol. xxv, p. 439].—New Coleoptera collected by the U. S. Boundary Commission; *J. L. LeConte.*—p. 89, Two new fossil Camels from Niobrara; *J. Leidy.*—p. 90, Munayunkia speciosa, a worm; *J. Leidy.*—p. 90, Age of Connecticut river, etc. sandstone formation; *I. Lea.*—p. 93, Prodromus, &c. Part V. New Crustacea collected by Mr. Stimpson of the North Pacific Expedition; *W. Stimpson.*—p. 110, Contributions to Helminthology; *J. Leidy.*—A new mineral, an anhydrous Sulphate of Potash containing ammonia, trimetric, and approaching remotely Glaserite; *W. J. Taylor.*—p. 114, Productiveness of some Unionidæ; *I. Lea.* —Note on American Land Shells, No. 3; *W. G. Binney.*—p. 116, A new Phyllostome Bat, from California; *S. F. Baird.*—p. 117, Two new species of Birds, from California; *J. X. de Vesey.*—A new Toxostoma from New Mexico; *T. C. Henry.* —Four new fresh-water Molluscs from Isthmus of Darien and Honduras; *I. Lea.* —Effects of Carb. Hydrogen Gas on certain exotic Plants; *G. W. Fahnestock.*

PROCEEDINGS BOSTON SOC. NAT. HIST. 1858. Vol. VI.—p. 289, Eggs of *Sarcoptes Hominis* and spores of *Pityriasis versicolor*; *J. C. White.*—p. 293 (and 310), Note on an Infusorial earth; and on the Sugar of Sorghum; *A. A. Hayes.*—p. 294, Development of *Anableps Gronovii.*—p. 294, Supposed Meteorite of Marblehead; *C. T. Jackson.*—p. 295, Analyses of Magnetite of Missouri Iron Mts.; *E. Harrison.* —p. 296, Cryptogams of the Lake Superior region; *S. Kneeland.*—p. 296, Sorghum Sugar; *C. T. Jackson.*—p. 297, Glucose of Sorghum; *A. A. Hayes; C. T. Jackson.* —p. 300, Parasites of Man; *D. F. Weinland.*—p. 302, On Gum Lahoe; *C. Stodder.* —p. 303, Remains of Equus major, the fossil horse, found near Troy, N. Y.; *Skilton.* —p. 304, Generation of the Helminths; *J. C. White.*—p. 307, Parasitic Gasteropod; *W. Stimpson.*—p. 309, Note on rocks of Wisconsin; *E. Daniels.*—p. 310, Analysis of Infusorial earth; *J. Green.*—p. 311, Porcupine shot in New Hampshire; *Storer.* —p. 315, Contributions to New England Mycology; *C. J. Sprague.*—p. 321, Botany of Sorghum vulgare; *C. J. Sprague; C. Pickering.*—p. 327 and 338, Vibration in water falling over dams; *W. Edwards.*—p. 328, Fishes carrying the eggs of other fishes in their mouths; eggs of fishes may hatch after traversing the intestinal canal of a bird.—p. 330, Note on a geological section from Greenfield to Claremont, Mass.; *C. H. Hitchcock; W. B. Rogers.*—p. 333, 339, 347, Sonorous action of jets of burning gas; *W. B. Rogers.*—p. 336, Human fœtus; *J. Wyman.*—p. 337 and 341, Sorghum Sugar; *C. T. Jackson; A. A. Hayes.*—p. 343, Plan adopted by Nature for the preservation of the various species of Helminths; *D. F. Weinland.*—p. 346, Locomotion of Lophobranchiate fishes; *D. F. Weinland.*—p. 352, On alcoholic beverages; *A. A. Hayes.*

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[SECOND SERIES.]

ART. XVII.—*On Deep Sea Soundings*; by Prof. W. P. TROWBRIDGE, Assistant U. S. Coast Survey. Report to Prof. A. D. BACHE, Superintendent U. S. Coast Survey.

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TO PROF. A. D. BACHE, SUPT. U. S. COAST SURVEY.

Dear Sir.—On receiving directions from you to examine the deep-sea soundings of Lieut. Comm. Joseph Dayman, R. N., along the line previously explored by Lieut. Com. Berryman, I took advantage of your suggestions and made an investigation of the laws of motion of the sounding weight and line used in deep-sea soundings. This seemed to offer the best mode of arriving at correct conclusions with regard to the probable errors of the results generally obtained by the methods employed, by which means only the values of the results can be determined, and comparisons of different results made.

Having had opportunities of consulting with you from time to time, I have been enabled to follow out your suggestions more satisfactorily than I could otherwise have done.

The substance of the report, which I have the honor to submit herewith, was given by your kind permission at the late Meeting of the American Association, and I have prepared it in a form to be printed with the proceedings of the Association if you should think it advisable.

The conclusions to which the investigations lead seem to be briefly, as follows:

1st. The sounding weight reaches its maximum velocity within the first three seconds of time after the weight has reached the surface; this maximum varies with the form and specific gravity of the weight, being

16 feet per second for a 32 pound shot and 27 feet for a 95 pound weight, such as was used by Lieut. Com. Dayman.

2d. When the line begins to offer resistance to the motion, the velocity is rapidly diminished, becoming at the depth of 2000 fathoms only two or three feet per second, and at 3000 fathoms, still less.

3d. This diminution of velocity is due entirely to the resistance offered by the line, the resistance offered by the sinker being at the depth of 2000 fathoms only a fraction of a pound, while that of the lines amounts to nearly the whole weight of the sinker; the excess of the weight of the sinker being sufficient to impart a very small velocity to the line.

4th. The resistance upon the line varies, 1st as the square of the velocity, 2nd as the diameter of the line, 3d as the length of line immersed.

5th. The variations of gravity do not sensibly affect the rate of sinking.

6th. The variations of density do not increase the resistance at great depths, but it appears that bodies which are compressible will fall more rapidly at great depths than near the surface.

7th. The smallest line that can be used with safety will give rise to sufficient resistance to support nearly the whole weight of the heaviest sinker at considerable depths.

8th. The probable errors of results where the length of line paid out is taken as the depth, are so great that this method is the most unreliable for determining the depth.

9th. The method of ascertaining the depth by Massey's Indicator is the best that has been devised, provided the indicator be always used with the same line and weight. This method however has also been very unsatisfactory, giving large errors on account of the faulty construction of the machines used.

10th. The results of Lieut. Com. Dayman were obtained from the former method, those of Lieut. Com. Berryman by the Indicator, and therefore Berryman's results are undoubtedly nearer the truth than Dayman's, but from neither can the existence of a "plateau" between Newfoundland and Ireland be made out.

There is yet, it seems to me, nothing to show that the bottom of the sea presents features any different from the face of the country across any portion of our territory, except perhaps the highest mountain ranges. The Highlands of the Hudson, for instance, would be unnoticed in this "plateau."

11th. To obtain correct results, some improved method of registering the depths seems to be necessary, and I would respectfully suggest a modification of Mr. Saxton's Current Indicator to suit the circumstances of the case.

I would also beg leave to suggest the coiling of the line within a cylinder which is to be attached to the weight, so that the line will uncoil from the moving body. By this means the resistance due to the motion of the line in the water, will be avoided. If this be practicable, much greater depths may be reached, and the weight will descend through all depths with a rapid and uniform velocity.

The mode of registering the depth may be the same as heretofore used, with less liability to error, on account of the short time required for the apparatus to sink to the bottom.

Where the time required for the weight and line to sink to the depth of 3000 fathoms is now one hour and a half, by the method proposed the apparatus might be made to sink to the same depth in fifteen or twenty minutes, and to smaller depths in proportionally less time.

Yours, very respectfully,

W. P. TROWBRIDGE,

Asst. U. S. Coast Survey.

Coast Survey Office, Washington, D. C., May 31st, 1858.

The explorations of the Gulf Stream by officers of our Navy, in connection with the survey of the coast, first gave rise to systematic efforts to determine sections of the bottom of the sea along continuous lines of great depth; afterwards, the extensive system of deep-sea soundings, executed under the direction of the Navy Department, through the exertions of Lieut. Maury, furnished most useful experience and results; and more recently the soundings along the line of the proposed Atlantic telegraph, first by Lieut. Commanding Berryman, U. S. Navy, and again by Lieut. Commanding Joseph Dayman, R. N., have shown that to reach the bottom of the sea is not beyond the power of human effort.

Notwithstanding so much has been done to overcome the practical difficulties which formerly embarrassed and discouraged any attemps to sound at great depths, it is undeniable that much uncertainty exists in the determinations that have been made, even where the depth is not greater than 2,000 fathoms; while below 2,000 or 2,500 fathoms, the errors and uncertainties amount to failures; and a limit has been reached beyond which it seems difficult to pass.

When the subject is viewed as a mechanical problem, it seems hardly possible, however, that insurmountable obstacles can exist to its practical solution. The facility with which an observer can place himself over any point, the distance of which below the plane on which he rests it is his object to determine, and from which he is separated by a medium freely and almost equally penetrable at all depths, the laws of which are well known, would seem to offer greater hopes of our being able ultimately to determine the depressions of the bottom of the ocean, by a greater number of observations and with greater accuracy, than the elevations of continents.

The solution of the question requires that the difficulties which have been found to exist in the present methods of sounding, should be clearly determined and overcome, and where these methods fail, that they should be improved if possible, or new ones substituted.

It will be seen on the least reflection that the difficulties are of a mechanical nature; not simply practical, for all that skill and experience can accomplish has been effected in overcoming the

practical difficulties which have been met in applying the ordinary methods; but the methods which are most naturally adopted for small depths fail when the depth is very great, on account of their inapplicability in the latter case.

It is important to separate those difficulties which may be overcome by skill and experience, from those which under the most favorable circumstances and conditions, are still as great as ever, and depend only upon the mechanical forces developed; and of course some proof will be required to show that the obstacles presented by the latter causes are, in the present mode of sounding, almost if not quite insurmountable.

If we suppose the water of the ocean to be in a state of rest, a sounding weight and line will descend according to the laws which govern the falling of heavy bodies in a resisting medium; the combined weight of the sinker and line, in the water, being the accelerating force, and the resistance offered by the water to the motion of the weight and line, the retarding force; and upon the relative magnitudes of these forces the circumstances of descent will depend.

The weight of the sinker and line in the water may be easily determined from their specific gravities, and for the purpose of determining the nature of the resistance upon these bodies, moving in the water, we have numerous experiments.

The experiments of Dubuat given in the "Principes d'Hydraulique," furnish data for determining the resistances to the motion of bodies whose forms and dimensions correspond to the sinkers generally used in sounding; and the numerous experiments in deep sea sounding, to which reference has been made, especially those of Lieutenants Lee and Berryman, U. S. Navy, afford the means of determining the resistance of the water upon the line.

In these latter experiments, the rate of descent was accurately observed and the results of numerous trials, with different weights attached to the same line, and with different lines, furnish the means of ascertaining the velocity of descent in each case, at every point of the path described by the falling body, with sufficient accuracy to determine all the circumstances of motion.

The problem then becomes one of the most simple in mechanics, viz.: having given the space, time, and velocity corresponding to the fall of a given weight in water, to find the law of resistance to the motion.

In some respects the problem is a new one. Although the resistances to the motion of any body, in water, under ordinary circumstances, are known to be proportional to the squares of the velocities, yet the experiments, from which this rule was deduced, were made upon bodies of certain regular forms, the

length of which, compared with the diameter of their cross section was not very great; and it will be at least interesting to know whether this law is true with reference to a line of great length and small diameter; and especially when this line is subjected to the great pressure which is exerted upon it in the depths of the ocean. The resistance in this case is entirely due to the velocity which is imparted to a certain quantity of water along the line, by its motion, and not to friction in the ordinary sense of the term. If the resistance from friction be at all considered, it must increase greatly with the depth, since the pressure is increased by fifteen pounds on every square-inch for every thirty four feet in depth. It will be seen by the subsequent discussion that the pressure has no influence in increasing the resistance.

Again, the density of the water at great depths, as affected by the compressibility of that fluid, must be considered, and also the variations of the force of gravity; which will of course depend upon the depth. These circumstances make the solution of the problem of interest, when considered in relation to the experiments which have been made upon the motion of bodies in water, under ordinary circumstances, at the surface of the earth; and the discussion of the subject should enable us to determine the best means of overcoming the difficulties which now exist in sounding to great depths.

The experiments of Lieutenants Lee and Berryman were made with one and two 32 pound shot, (iron) the line used being about seven hundredths of an inch in diameter, and capable of bearing a strain of 60 pounds; the weight of 100 fathoms, in air, being about 1 pound.

The mode of observing was as follows: several thousand fathoms of the line were coiled upon a reel of light construction, marks being first placed along the line at intervals of 100 fathoms; the end of the line was then attached to the weight, one or two thirty-two pound shot, as the case might be, and the shot dropped into the sea. The rate of descent was observed by noting the time of running out of each 100 fathoms, by a chronometer. The experiments were made from a boat, which was kept accurately over the descending line by the oars. In this manner the effects of the drifting of the boat in giving apparently a more rapid descent and a greater depth, was avoided, and although it is probable that in many instances the drift of the boat was considerable, yet the mean results of the experiments of Lieutenants Lee and Berryman from observations extending through several years, differ only by a small constant quantity which is inappreciable in the determination of velocities to the depth of 1000 fathoms; and below this the difference is still slight. I have therefore made use of the experiments of

Lieutenant Lee, which in some respects are preferable, (and which are sufficiently numerous to give good results,) rather than a mean of the results of Lee and Berryman.

The intervals of descent for one and two thirty-two pound shot are given in the table (I); the first column shows the depth in fathoms, the second the intervals of descent, in time, for each successive 100 fathoms.

The velocities are determined from these intervals by supposing the motion uniform during the running out of each one hundred fathoms, and dividing the space, in feet, by the time in seconds, which will give, very nearly, the velocity in feet at 50, 150, 250, &c. fathoms. The velocities at these points are given in the third columns under their respective heads.

It will be observed that the velocities of descent diminish, in the case of one 32-pound shot, from 8·83 feet per second at 50 fathoms, to 2·84 feet at 1000, and 2·09 feet at 2000 fathoms, and so on. And in the case of two 32-pound shot, from 12·50 feet per second at 50 fathoms, to 3·48 feet at 1000, and 2·99 feet at 2000.

The curves representing these circumstances of motion are given in diagrams marked (A), the vertical distances representing the spaces in fathoms and the horizontal distances for curves (1) and (2) representing intervals of time, and for curves (3) and (4) velocities in feet. Curves (1) and (2) therefore show the relation of the spaces and times, and curves (3) and (4) the relation of spaces and velocities. The curves in full lines are for one 32-pound shot, and those in broken lines for two 32-pound shot; the sounding line being the same in both cases. As these bodies have no initial velocity but start from rest at the surface, it is evident that the curves of velocity must pass through the origin (*O*), and as their velocities are already diminishing rapidly at 50 fathoms, it is interesting to determine the point of maximum velocity. For this purpose we must refer to the mathematical formulæ for the motion, which are well known. In case of a heavy body falling in water, the velocity expressed in terms of time, weight, density of medium, and form of body, is given by the following expression:

$$V = \sqrt{\frac{2\,g\,W}{S\,.\,D\,(m+q)}}\left(\frac{N-1}{N+1}\right)$$

in which (g) represents the force of gravity, (W) the weight of the body in water, (S) the area of the greatest cross section of the body, (D) the density of water, and ($m+q$) a constant determined by experiment; and, (the hyperbolic logarithm of N)

$$= \frac{t}{P}\sqrt{2\,g\,W\,.\,S\,.\,D\,(m+q)}.$$

In this latter expression (P) represents the weight of the body in air, including also the weight of the fluid drawn along by the body; and (t) the time in seconds.

The velocity will increase as (t) increases, and will become constant when the factor $\frac{N-1}{N+1}$ becomes unity; and it is evident that when (t) becomes so great that N may be taken for $N-1$ and $N+1$, without sensible error, the velocity will have become nearly constant, and will be represented by

$$V=\sqrt{\frac{2gW}{S.D.(m+q)}}$$

In the case under consideration $g=32{\cdot}189$ (feet), $W=27{\cdot}38$ (pounds), the weight of a 32-pound iron shot in sea water, $S=0{\cdot}21$ (square feet), D represents the weight of one cubic foot of sea water $=64{\cdot}177$ (pounds), and $(m+q)$ as determined by Dubuat in the experiments given in the "Principe d'Hydraulique" for a sphere moving in water $=0{\cdot}5$. These constants substituted in the formula give for one 32-pound shot, falling freely in sea water.

$V=16{\cdot}21$ (feet per second) for the maximum velocity.

To find the space passed over, before this velocity is reached, we have this expression,

$$Z=\frac{2P}{S.D\,(m+q)}.\log\frac{N+1}{2\sqrt{N}},$$

or when $N+1$ may be taken for N this expression may be placed under the form

$$Z=\frac{2P}{S.D\,(m+q)}(\tfrac{1}{2}\frac{t}{P}\sqrt{2g\,W.S\,D\,(m+q)}-L.2).$$

The time which must elapse before N becomes so great that $N+1$ may be taken for it, may be determined from the expression

$$L.N=\frac{t}{P}\sqrt{2g\,W.S.D\,(m+q)}.$$

Substituting in this expression the values of the known quantities for a 32-pound shot we have

$$L.N=t.(3{\cdot}13)$$

For 1 second $L.N=3{\cdot}13$ and $N>10$; for 2 seconds $L.N=6{\cdot}26$ and $N=1000$ nearly; for 3 seconds $L.N=9{\cdot}39$ and $N=10{,}000$ nearly.

Thus at the end of the third second N becomes so great that $N+1$ may be taken for it, without sensible error, in determining the velocity and space; and the formula for the space gives for the first and second seconds, 1 sec. $Z=9{\cdot}11$ feet, 2 sec. $Z=25$ feet, nearly, and $16{\cdot}21$ (feet) for each second afterwards.

The velocity of the shot reaches its maximum therefore before the resistance of the line has any great effect in retarding its motion; that is, during the first two or three seconds. Two 32-pound shot placed side by side will of course fall in the same time, and will attain the same maximum velocity, and the value, 16·21 (feet) will be also the maximum for two 32-pound shot; when the resistance of the water upon the line is developed, however, the greater weight will have the greater power of overcoming this resistance, and its velocity will be retarded less than in the case of one 32-pound shot, and the curves representing the velocities will commence to diverge at the maximum point.

It will be seen from the curves that the velocities diminish very rapidly for the first three or four hundred fathoms, then more slowly, and in case the specific gravity of the line is nearly the same as that of water, the vertical OC will become tangent to the curve of velocity at an infinite distance; and will become sensibly tangent at the depth of a few thousand fathoms, or in other words, the velocity of the sounding weight will be almost entirely destroyed. If the line is much heavier than water, and incompressible, as in the case of a wire, the velocity will reach a minimum at a certain depth, generally less than 2000 fathoms and will afterward increase. Both of these cases have important bearings, as will be seen hereafter.

The velocities as determined from experiment, show but little diminution below 2000 fathoms; but the number of cases below that depth was much less than at smaller depths, and moreover the difficulty of determining the intervals correctly, below this depth, is very great; the action of currents on the line, the drift of the boat, &c., when three miles of line are out, would affect the determinations greatly, and it seems to be preferable to determine these lower velocities by induction: instead of finding a velocity of two feet at 3000 fathoms, the actual velocity as determined by the curve, will not be greater than one foot and a half.

The curves of velocities seem to approach nearer to the hyperbola than any other form.

The resistances which cause this diminution of velocity in the descent, are due entirely to the constant increase in the length of line, since as we have seen the resistance which would be due to the shot falling alone corresponds to a constant velocity of 16·41 feet; and as the velocity is diminished, the resistance to the shot is diminished. To separate the resistance upon the line from that due to the shot, and to find the amount of these forces in pounds, we have for the resistance upon the shot at any point

$$R = S.D(m+q)h,$$

(h) being the height due to the velocity; and if at any point of the path described the motion be supposed uniform, for one second, we shall have, calling (W) the weight of the shot and line in water, (R') the resistance upon the line, and (R) the resistance upon the shot or sinker

$$W-(R+R')=0,$$

that is, the resistance is equal to the weight. This is the simplest mode of considering the subject. If the inertia of the masses be taken into account, we must employ the expression

$$\int_b^a W\,dz-\int_b^a R\,dz-\int_b^a R'\,dz=\tfrac{1}{2}M(v^2-v'^2)$$

v and v' being the velocities at any two depths (a) and (b) and the first member representing the quantity of action of the accelerating and retarding forces.

The term $\frac{1}{2}M(v^2-v'^2)$ involves the resistance opposed by the inertia of the shot and line while the velocity is diminished from v to v', and the resistance opposed by the inertia of a quantity of line equal to the distance $(b-a)$ as it is drawn from the reel at rest, and a velocity v' imparted to it. If the distance $(b-a)$ equal unity, or one foot, v and v' may be considered equal, and the latter expression reduces to the first equation; and by finding the relation between the quantities in the first equation, at different points of the depth, the values of the forces at these points will become known, and their variation with the depth will be exhibited.

The expression $W-(R+R')=0$ or $W-(S.D(m+q)h-R')=0$ involves two variable quantities (g) the force of gravity and (D) the density of the water.

The variations of gravity within the external surface of the earth, supposing the density of water to be the mean density of the earth, are proportional to the distance from the centre of the earth, and if (g) represent the force of gravity at the surface, (g') the same force at the depth z, and (r) the radius of the earth, we shall have

$$g'=g\left(\frac{r-z}{r}\right)=g-g\frac{z}{r}$$

The equatorial radius in fathoms is equal to 3487266, and at the equator for a depth of 3000 fathoms we shall have

$$g'=g-g\frac{3000}{3487266},$$

the second term being only ·0004 of the force of gravity; but the density of the water is less than the mean density of the earth, and the force of gravity will therefore not diminish with the depth, but in a less ratio; so that the amount of diminution at 3000 fathoms will be less than ·0004 of the force; we may

therefore consider the force of gravity constant; and in reality its diminution due to depth will be less than its variation with the latitude on the surface.

The density of the water increases with the depth, according to the law of compressibility of water, and to find the variations of density with depth we must refer to the law of compressibility.

From a report of Mr. Schott it appears that the shortening of a column of water from the pressure due to 600 fathoms is two fathoms; or the cubical diminution is about ·0001 of volume for one atmosphere.

The density being inversely as the volumes, for a given weight, we shall have, supposing (D) to be the density at the surface, and (D') the density at the depth (z)

$$D' = D \cdot \frac{1}{1 - \cdot 0001 \cdot \frac{z}{33 \cdot 90}}.$$

From this expression we find the density at the surface equal 1·029, at 1000 fathoms 1·048, at 2000 fathoms 1·066, 3000 fathoms 1·084. This increase of density is too small to affect sensibly the buoyancy of the fluid, or the resistance to motion, when considered with reference to the quantities which we wish to determine.

The weight of a 32-pound shot, for instance, in water, at the surface will be

$$W = 32 - 32 \cdot \frac{1 \cdot 029}{7 \cdot 2},$$

the numerator and denominator of the last term being the specific gravities, respectively, of water and cast iron.

At 3000 fathoms the weight of the shot would be

$$W = 32 - \frac{1 \cdot 084}{7 \cdot 2},$$

and we see that the variations fall within the range of the specific gravities of the different varieties of cast iron.

The variation as affecting the resistance to motion will be shown in the expression

$$R = S \cdot D\,(m+q)\,h,$$

where it is impossible to determine $(m+q)$ or h within the range of variations of D. We may therefore regard all the quantities as constant, and known, in the expression

$$W - (S \cdot D\,(m+q) \cdot h \cdot) - R' = 0,$$

except R' which represents the resistance upon the line, and may be determined from the equation.

If the specific gravity of the line be very different from that of water, we shall have

$$W = W \pm W' z,$$

in which ($W'z$) is the weight of that part of the line immersed; the plus sign being used when the line is heavier than water, and the minus sign when it is lighter; and (W') being the weight in water of one foot of line.

In the experiments with one and two 32-pound shot the specific gravity of the line is supposed to be the same as that of water, and it is only in case of a wire being used, or a hemp line of large diameter, that it is necessary to take the specific gravity into account. As we wish to determine the *laws* of the resistances and not their absolute quantities in pounds, except in general terms; these very small quantities may with propriety be neglected.

We may now find the values of R' at different depths in the cases under consideration, viz., the fall of one and two 32-pound shot attached to a small line.

For one 32-pound shot $W=27{\cdot}36$ pounds, and the values of $S.D(m+q)h.$ for the different velocities in the third column of the table may be calculated. At the maximum velocity there is practically no line attached, as the action of a few feet may be neglected, and the whole resistance will be equal to 27·36 pounds, or equal to the weight of the shot in water, which is determined also from the expression

$$V=\sqrt{\frac{2gW}{S.D(m+q)}},$$

from which $R=S.D(m+q)\frac{V^2}{2g}=W=27{\cdot}36$ pounds.

The resistances to the shot are given in the fifth column of the table, and the curve representing these resistances, in pounds, is given in diagrams marked (B) curve No. 1.

The values of $R'=W-S.D.(m+q)h.$ are given in the sixth column of table I.

It will be seen that the resistance to the shot diminishes very rapidly at first, and at the depth of 2000 fathoms it becomes only 0·5 of a pound, while the resistance upon the line increases with the depth, becoming at 2000 fathoms $27{\cdot}36-0{\cdot}5=26{\cdot}8$ pounds.

For two 32-pound shot with the same line the resistances at the maximum velocity will be 54·72 pounds, and at 2000 fathoms 1·97 pounds; the tension of the line in this case is, at 2000 fathoms, nearly equal to its bearing weight, which was only 60 pounds. How much farther would it have gone without breaking and thus *indicating bottom?*

The diagrams marked (B) represent the laws of the resistances to the sinker or shot and to the line, respectively. The curves in full lines relate to one 32-pound shot, and those in broken lines to two 32-pound shot. Curves (1) and (2) represent the resistance to the *shot*, in pounds, at depths 50, 150, 250, etc.

fathoms; the abscissæ representing pounds. Curves (3) and (4) represent the resistances to the *line* at corresponding depths.

Diagrams in every respect similar have been made for the descent of sinkers of 126 and 96 pounds, attached to the ordinary deep-sea line, which is about $\frac{4}{10}$ths of an inch in diameter, and also for weights of 35 and 96 pounds, attached to a silk line $\frac{1}{10}$th of an inch in diameter. These latter results were obtained from the observations of Lieutenant Commanding Joseph Dayman, who sounded across the Atlantic along the line proposed for the ocean telegraph, in the summer of 1857. The deductions from Lieutenant Dayman's experiments confirm those obtained from the observations of Lieutenants Lee and Berryman.

A glance at the tables or curves will show, 1st, that the velocity of a descending weight and line, even with the smallest line, diminishes very rapidly after it has attained its maximum, which always occurs very near the surface; 2d, that at the depth of about 2000 fathoms the velocity is hardly two feet per second; 3d, that at this point nearly the whole resistance is due to the line, the resistance to the sinker being only a fraction of a pound; 4th, the resistance upon the *line* increases with the depth, becoming nearly equal to the weight, at 2000 fathoms; 5th, comparing the resistance upon the line when attached to one 32-pound shot and two 32-pound shot, respectively, these resistances for the same depth, or length of line, seem to be proportional to the squares of the velocities. To determine whether this law be true, table V has been constructed, in which the ratios of the resistances in pounds at the same depth in the two cases, are compared with the squares of the velocities. The ratios agree very nearly, the means differing by only a small fraction.

In table IV the same result is obtained with a larger line, the deep-sea line, the moving weights being 126 and 96 pounds.

We may therefore conclude that for the same length of line moving with different velocities the resistances are proportional to the squares of the velocities.

To ascertain the law of variation with the length, I have taken those points in the two cases at which the velocities are the same, corresponding of course to different depths or lengths. The results are given in table III, where the ratios of the lengths are compared with the ratios of the resistances. From this table it appears that the resistances are directly proportional to the lengths.

That is, if R represent the resistance upon a given length, moving with a velocity V; the resistance upon double the length, moving with the same velocity, will be $2R$.

This does not appear to hold true for all depths, for if we take the differences between the lengths corresponding to the same

velocity, for different velocities, or what is the same thing, different depths, and compare these differences of length with the differences of resistances, the resistances appear to diminish with the depth. This is particularly the case with the deep sea line where a given pressure of the water will have a greater effect in diminishing the diameter. It would seem to be a result which ought to have been expected, viz.: that in case of compressible lines, the pressure of the water instead of increasing the resistance to motion, diminishes it, since the combined tension and pressure tend to diminish the diameter of the line; while, as we have seen the change of density is so small that no sensible increase of resistance to motion among the particles, is produced.

This fact I do not consider *conclusively* shown by the investigation, for although in the last two columns of tables VI, VIII the numbers expressing the ratios of resistances when compared with the ratios of the lengths, appear to diminish with the depth, yet from a want of knowledge of the diameter and specific gravity of the lines used, it is impossible to detect very slight variations in the resistances. The conclusion is a natural one, however, that the diameter of the line being diminished by the combined pressure and tension, the resistance will diminish with the depth.

The observations which I have discussed are not sufficiently numerous to determine with certainty the influence of increasing or diminishing the diameter of the line. Taking the deep sea line and the small line, seven hundredths of an inch in diameter, the resistances to the same length moving with the same velocity appear to be proportional to the diameter. Table (VII). The diameters were probably as 1 to 3 or 4, but the diameter of the deep sea line was not exactly given.

The resistance of the water upon a sounding line, may therefore be represented by the following expression,

$$R = (\text{constant}) \times \sqrt{S} . l . v^2,$$

in which S represents the cross section of the line, l the length, and v the velocity.

The constant must be determined by experiment.

From these results we are justified in drawing the following conclusions.

1st. The resistance to the sinker, forming such a small part of the whole resistance at great depths, its form is not a matter of importance. 2d. With regard to its weight; the effect of a heavier sinker is to increase the velocity during the first part of the motion, which develops a greater amount of resistance upon the line, requiring of course a stronger line: with the line used in the experiments with two 32-pound shot, the resistance became so great at the depth of 2000 fathoms, that a slight

addition to the velocity by means of a greater weight, would have broken the line; and this result generally attended all attempts to make very deep soundings with the line attached to three or four 32-pound shot. Thus increasing the weight requires a larger line and causes an increase of the resistance in the double ratio of the diameter of the line and the square of the increased velocity, the resulting velocity at great depths will therefore remain nearly the same; a result which is found in practice.

The experiments with one 32-pound shot attached to a small line, given above, probably involve the most favorable conditions, as far as regards the weight, form of weight, and diameter of the line.

3d. The uncertainty of knowing the exact instant of the weight striking the bottom, the effect of drift or currents, and the great loss of velocity in the descent, requiring so much time for a single cast, are therefore difficulties which cannot be overcome by this mode of sounding, and there is a limit at two or three thousand fathoms depth, beyond which, the method practically fails, and even at less depths large errors must enter into the results.

The effect of increasing the specific gravity of the line as in making use of wire, is unfavorable, since at a certain depth the weight of the wire alone must overcome the resistance offered by the water, and it would run out of its own weight. The depth at which this would occur for a wire $\frac{7}{100}$ of an inch in diameter is about 1700 fathoms; and for a wire $\frac{3}{100}$ of an inch in diameter, 400 fathoms.

The same difficulty occurs when a large hempen line is used; a line two inches in diameter of this material would run out of its own weight with a velocity of 3 feet per second at the depth of 1900 fathoms. An instance of this kind is given in the experiment of Lieut. Joseph Dayman, R. N., in sounding across the Atlantic in 1857.

Table No. IX gives the results of the experiment referred to; when the line was hauled in, 200 fathoms of it were coiled upon the sinker, the latter having struck bottom at 2200 fathoms.

The next consideration is the mode of noting or measuring the depth within the limits which are accessible. For this purpose several plans have been followed, none of which have been so successful that the degree of accuracy attained, or the probable error of the determination, might be estimated.

The most natural method is to measure the length of the line paid out. The errors arising from the drifting of the vessel, and currents acting upon a long length of line in the water, may in this case amount to as much as the depth, and the method has accordingly been rejected entirely, where there is any current or drift. Computing the depth from the time and rate of descent

is another mode which in the manner in which it has been applied, is unreliable; especially on account of the difficulty of noting the exact instant when the sinker strikes the bottom.

The most successful plan thus far is to attach a self registering indicator to the weight, the indicator being brought back to the surface and the weight detached at the bottom.

The indicator heretofore used is known as "Massey's Indicator" and although theoretically well adapted to the purpose to which it is applied, yet on account of faults in its construction, the results obtained by its use, at great depths, have not been satisfactory; and in fact are of little more value than the determinations by the length of line paid out. In the soundings across the Atlantic in 1857 Lieutenant Commanding Dayman rejects the determinations by the indicator after numerous experiments to ascertain what he called its "index errors." The difficulty seems to be in the small surface given to the helix, the great size of the axis upon which the helices are placed, the friction of the wheel-work and, generally, the clumsy construction of the machine which prevents the helix from revolving with equal facility at all velocities. The comparisons made by Lieutenant Dayman show that different machines attached to the same sounding weight will give very different indications, and the same machine will give different indications when attached to different weights, and different lines.

The "Current Indicator" invented by Mr. Joseph Saxton of the office of Weights and Measures might, by very slight modifications, be applied to the purpose of sounding, and would be, in every respect, superior to Massey's.

With all its imperfections however, Massey's indicator furnishes better results when carefully used, than the method of measuring the depth by the line out; and for this reason I think the soundings of Lieut. Berryman where he used the indicator, on the line of the Atlantic telegraph, are much nearer the truth than those of Lieut. Dayman.

In both cases the probable errors are very large, amounting in many instances, I think, to several hundred fathoms.

The idea of a "Plateau" existing between Newfoundland and Ireland is not warranted it seems to me by any observations that have yet been made. The range of errors may be as great as 500 fathoms, which would admit of the existence of a submarine mountain on this line, half as high as Mount Washington. A true section of the Atlantic can only be determined by improved modes of sounding, since from the preceding discussion we may be warranted in the conclusion that it is practically impossible to determine the greatest depths of the ocean by the methods now in use.

I.—*Table showing the rates of descent and resistances in pounds upon the sinker and line in sounding with one and two 32-pound shot, attached to a line ·07 of an inch in diameter.*

Depth Faths.	One 32-pound Shot.					Two 32-pound Shot.				
	No. of Casts.	Intervals of Times of Descent.	Velocity	Resist. to Sinker.	Resist. to Line.	No. of Casts.	Intervals of Times of Descent.	Velocity.	Resist. to Sinker.	Resist. to Line.
		Min. Sec.	Feet.	Pounds.	Pounds.		Min. Sec.	Feet.	Pounds.	Pounds.
0			16·41	27·36					54·72	
50			8·83	8·15	19·15			12·50	32·70	22·02
100		1 08					0 48			
150			6·66	4·64	22·72			9·40	18·49	36·23
200		1 30					1 04			
250			5·41	3·06	24·30			7·32	11·21	43·51
300	29	1 51				27	1 22			
350			4·65	2·26	25·10			6·45	8·70	46·02
400	29	2 09				28	1 33			
450			4·14	1·81	25·55			5·61	6·58	48·14
500	29	2 25				28	1 47			
550			3·77	1·50	25·86			5·36	6·01	48·71
600	29	2 39				28	1 52			
650			3·55	1·33	26·03			4·81	4·98	49·74
700	27	2 49				22	2 03			
750			3·37	1·20	26·16			4·76	4·85	49·87
800	26	2 58				18	2 06			
850			3·11	1·02	26·34			4·48	4·30	50·42
900	27	3 13				16	2 14			
950			2·94	·91	26·45			4·23	3·83	50·89
1000	26	3 24				16	2 22			
1050			2·84	·85	26·51			4·03	3·48	51·24
1100	22	3 31				16	2 29			
1150			2·66	·75	26·65			3·85	3·17	51·55
1200	21	3 45				14	2 36			
1250			2·66	·75	26·65			3·73	2·98	51·74
1300	19	3 45				11	2 41			
1350			2·53	·68	26·68			3·45	2·55	52·17
1400	18	3 57				11	2 54			
1450			2·43	·62	26·74			3·44	2·53	52·19
1500	19	4 07				11	2 56			
1550			2·37	·59	26·77			3·26	2·28	52·44
1600	17	4 18				10	3 04			
1650			2·31	·56	26·80			3·23	2·23	52·49
1700	17	4 20				8	3 06			
1750			2·25	·53	26·83			3·19	2·18	52·54
1800	17	4 26				7	3 08			
1850			2·21	·51	26·85			3·08	2·03	52·69
1900	15	4 31				7	3 15			
1950			2·15	·48	26·88			3·06	2·00	52·72
2000	12	4 39				5	3 16			
2050			2·09	·44	26·92			2·99	1·91	52·81
2100	8	4 47				5	3 21			
2150			2·08	·43	26·93			2·93	1·84	52·88
2200	6	4 48				3	3 25			
2250			2·04	·41	26·95			2·84	1·73	52·99
2300	5	4 54				2	3 31			
2350			1·91					2·83	1·71	53·01
2400	4	5 13				2	3 32			
2450			1·99					2·67	1·53	53·19
2500	4	5 01				2	3 45			
2550	*	*	2·03				*	2·69	1·55	53·17

* In every instance the invervals became irregular and unreliable below 2500 fathoms.

TABLE I. (Continued.)

Depth	One 32-pound Shot.					Two 32-pound Shot.				
	No. of Casts.	Intervals of Times of Descent.	Velocity.	Resist. to Sinker.	Resist. to Line.	No. of Casts.	Intervals of Times of Descent.	Velocity.	Resist. to Sinker.	Resist. to Line.
Faths.		Min. Sec.	Feet.	Pounds.	Pounds.		Min. Sec.	Feet.	Pounds.	Pounds.
2600	3	4 56				1	3 43			
2650			1·83							
2700	3	5 27								
2750			2·22							
2800	1	4 30								
2850			2·11							
2900	1	4 44								
2950			2·14							
3000	1	4 40								

II.—*Table showing the rates of descent and resistances in pounds upon the sinker and line in sounding with* 96 *and* 126 *pound weights attached to a deep-sea line, four tenths of an inch in diameter.*

Depth.	96 pound Weight. Deep Sea Line.				126 pound Weight. Deep Sea Line.			
	Intervals of Times of Descent.	Velocity.	Resist. to Sinker.	Resist. to Line.	Intervals of Times of Descent.	Velocity.	Resistance to Sinker.	Resistance to Line.
Fath's.	Min. Sec.	Feet.	Pounds.	Pounds.	Min. Sec.	Feet.	Pounds.	Pounds.
0		27·26	82·03			26·99	106·26	
50		11·54	14·39	67·64		13·93	29·24	80·02
100	0 52				0 43			
150		7·41	6·08	75·95		8·44	10·68	98·58
200	1 21				1 11			
250		5·94	3·91	78·12		6·82	6·97	102·29
300	1 41				1 28			
350		5·17	2·96	79·07		5·60	4·70	104·56
400	1 56				1 47			
450		4·69	2·44	79·59		5·31	4·29	104·97
500	2 08				1 53			
550		4:35	2·10	79·93		5·04	3·81	105·45
600	2 18				1 59			
650		4·11	1·87	80·16		4·89	3·59	105·67
700	2 26				2 05			
750		3·89	1·64	80·39		4·48	3·10	106·16
800	2 34				2 14			
850		3·73	1·54	80·49		3·98	2·38	106·88
900	2 41				2 31			
950		3·61	1·44	80·59		4·19	2·65	106·61
1000	2 46				2 23			
1050		3·47	1·33	80·70		3·98	2·38	106·88
1100	2 53				2 30			
1150		3·37	1·26	80·77		4·05	2·44	106·82
1200	2 58				2 28			
1250		3·33	1·23	80·80		3·92	2·29	106·97
1300	3 00				2 33			
1350		3·37	1·27	80·76		3·87	2·23	107·03
1400	2 58				2 35			
1450		3·24	1·17	80·86		3·61	1·94	107·32
1500	3 05				2 46			
1550		3·11	1·08	80·95		3·53	1·85	107·41
1600	3 13				2 50			
1650		3·00	1·00	81·03		3·41	1·72	107·54
1700	3 16				2 56			

TABLE II. (Continued.)

Depth.	96 pound Weight. Deep Sea Line.				126 pound Weight. Deep Sea Line.			
	Intervals of Times of Descent.	Velocity.	Resist. to Sinker.	Resist. to Line.	Intervals of Times of Descent.	Velocity	Resistance to Sinker.	Resistance to Line.
Fath's.	Min. Sec.	Feet.	Pounds.	Pounds.	Min. Sec.	Feet.	Pounds.	Pounds.
1750		2·90	·93	81·10				
1800	3 16							
1850		2·80	·87	81·16				
1900	3 27							
1950		2·70	·81	81·22				
2000	3 43							
2050		2·70	·81	81·22				
2100	3 43							
2150		2·47	·68	81·35				
2200	4 03							

III.—*Table showing influence of different lengths of line moving with the same velocity. Ratios of length to ratio of resistances.*

Velocity.	Depth.		*R.*	*R'*	Ratio of Lengths.	$\frac{R'}{R}$	Depth.		*R*	*R'*	Ratio of Lengths.	$\frac{R'}{R}$
	1 32-lb. Shot.	2 32-lb. Shot.	1 32-lb. Shot.	2 32-lb. Shot.			96-lb. Weight.	126-lb. Weight.	96-lb. Weight.	126-lb. Weight.		
Feet.	Fath.	Faths.	P'nds.	P'nds.			Fath's.	Fath's.	P'nds.	Pounds.		
8·	70	200			2·857		120	175			1·458	
7·5	100	220			2·200		140	200	71·6	96·8	1·428	1·352
7·	120	280			2·325		170	240	73·8	100·0	1·411	1·355
6·5	150	340	21·7	47·6	2·266	2·193	200	280	75·2	101·5	1·400	1·350
6·	190	420	23·2	48·5	2·211	2·090	240	330	76·6	102·7	1·375	1·341
5·5	230	510	24·5	49·3	2·217	2·012	300	400	77·8	103·9	1·333	1·336
5·	290	640	25·7	50·0	2·206	1·945	380	500	78·8	104·9	1·315	1·331
4·5	350	820	26·7	50·8	2·342	1·902	520	660	79·6	105·7	1·269	1·328
4·	480	1080	28·2	51·8	2·250	1·837	710	880	80·2	106·5	1·239	1·328
3·5	650	1400	29·7	52·4	2·153	1·764	1080	1340	80·7	107·2	1·240	1·328
3·	880	1900	31·3		2·159		1650		81·2			

IV.—*Table showing velocities and resistances at different depths and comparison of squares of velocities to resistances. Observations made with* **96 *and* 126-*pound weights. Deep-sea line.***

Depth.	96-lb. Weight.		126-lb. Weight.		Ratios of Squares of Velocities.	Ratios of Resistances to Lines.
	Velocity.	Resistance to Line.	Velocity.	Resistance to Line.		
Fathom .	Feet.	Pounds.	Feet.	Pounds.		
0	27·26		26·99			
50	11·54	67·64	13·93	80·02	1·457	1·183
150	7·41	75·95	8·44	98·58	1·297	1·298
250	5·94	78·12	6·82	102·29	1·318	1·310
350	5·17	79·07	5·60	104·56	1·173	1·322
450	4·69	79·59	5·31	104·97	1·282	1·319
550	4·35	79·93	5·04	105·45	1·342	1·319
650	4·11	80·16	4·89	105·67	1·414	1·318
750	3·89	80·39	4·48	106·16	1·326	1·321
850	3·73	80·49	3·98	106·88	1·138	1·328
950	3·61	80·59	4·19	106·61	1·347	1·323
1050	3·47	80·70	3·98	106·88	1·316	1·325
1150	3·37	80·77	4·05	106·82	1·444	1·322

V.—*Table showing velocities and resistances at different depths and comparison of squares of velocities to resistances. Observations made with one and two 32-pound shot. Small line.*

Depth.	One 32-pound Shot.		Two 32-pound Shot.		Ratios of Squares of Velocities.	Ratios of Resistances to Lines.
	Velocity.	Resistance to Line.	Velocity.	Resistance to Line.		
Fathoms.	Feet.	Pounds.	Feet.	Pounds.		
0	16·41		16·41		1·000	
50	8·83	19·15	12·50	22·02	2·004	1·150
150	6·66	22·72	9·40	36·23	1·992	1·595
250	5·41	24·30	7·32	43·51	1·831	1·790
350	4·65	25·10	6·45	46·02	1·924	1·833
450	4·14	25·55	5·61	48·14	1·843	1·884
550	3·77	25·81	5·36	48·71	2·021	1·887
650	3·55	26·03	4·88	49·74	1·890	1·911
750	3·37	26·16	4·76	49·87	1·995	1·906
850	3·11	26·34	4·48	50·42	2·084	1·914
950	2·94	26·45	4·23	50·89	2·070	1·924
1050	2·84	26·51	4·03	51·24	2·014	1·933
1150	2·66	26·65	3·85	51·55	2·095	1·934
1250	2·66	36·65	3·73	51·74	1·966	1·941
1350	2·53	26·68	3·45	52·17	1·859	1·911
1450	2·43	26·74	3·44	52·19	2·004	1·907
1550	2·37	26·77	3·26	52·44	1·892	1·914

VI.—*Table showing influence of lengths at different depths.*

Velocity.	Depth.		Diff.	$R'-R$	R	Ratio of Lengths.	Ratio of Resistances.	Depth.		Diff.	$R'-R$	R	Ratio of Lengths.	Ratio of Resistances.
	1 32-lb. Shot.	2 32-lb. Shot.						96-lb. Weight.	126-lb. Weight.					
Feet.	Fath.	Fath.	Fath.	Pounds	P'ds.			Fath.	Fath.	Fath.	Pounds	P'ds.		
8·	70	200						120	175					
7·5	100	220						140	200		25·2	71·6		2·841
7·	120	280						170	240		26·2	73·8		2·817
6·5	150	340	190	25·9	21·7			200	280	80	26·3	75·2	2·50	2·859
6·	190	420	230	25·3	23·2	1·211	1·090	240	330	90	26·1	76·6	2·66	2·938
5·5	230	510	280	24·8	24·5	1·217	1·012	300	400	100	26·1	77·8	3·00	2·981
5·	290	640	350	25·3	25·7	1·207	0·984	380	500	120	26·1	78·8	3·17	3·019
4·5	350	820	470	24·1	26·7	1·343	0·903	520	660	140	26·1	79·6	3·71	3·049
4·	480	1080	600	23·6	28·2	1·250	0·837	710	880	170	26·3	80·2	4·18	3·072
3·5	650	1400	750	22·7	29·7		0·764	1080	1340	260	26·5	80·7	4·16	3·045
3·	880	1900	1020		31·3			1650				81·2		

VII.—*Comparison of resistances upon the same lengths of lines of different diameters, moving at the same velocity.*

Velocity.	Deep Sea Line.			Small Line.		
	Depth. 96 lb. Weight.	*R.*	Resistance upon one Fathom.	Depth. 1 32-lb. Shot.	*R.*	Resistance upon one Fathom.
Feet.	Fathoms.	Pounds.	Pounds.	Fathoms.	Pounds.	Pounds.
8·	120			70		
7·5	140	71·6		100		
7·	170	73·8		120		
6·5	200	75·2	0·3765	150	21·7	0·144
6·	240	76·6	0·3191	190	23·2	0·122
5·5	300	77·8	0·2593	230	24·5	0·106
5·	380	78·8	0·2073	290	25·7	0·088
4·5	520	79·6	0·1530	350	26·7	0·076
4·	710	80·2	0·1129	480	28·2	0·058
3·5	1080	80·7	0·0747	650	29·7	0·045
3·	1650	81·2	0·0492	880	31·3	0·035

VIII.—*Table showing influence of lengths at different depths.*

Velocity.	Depth. 1 32-lb. Shot.	Depth. 2 32-lb. Shot.	Diff.	*R'*—*R*	*R'*	Ratio of Lengths.	Ratio of Resistances.	Depth. 96-lb. Weight.	Depth. 126-lb. Weight.	Diff.	*R'*—*R*	*R'*	Ratio of Lengths.	Ratio of Resistances.
Feet.	Fath.	Fath	Fath.	Pounds	P'ds.			Fath.	Fath.	Fath.	Pounds	P'nds.		
8·	70	200						120	175					
7·5	100	220						140	200			96·8		
7·	120	280						170	240			100·0		
6·5	150	340	190	25·9	47·6	1·789	1·838	200	280	80	26·2	101·5	3·500	3·874
6·	190	420	230	25·3	48·5	1·826	1·917	240	330	90	26·1	102·7	3·666	3·935
5·5	230	510	280	24·8	49·3	1·821	1·988	300	400	100	26·1	103·9	4·000	3·981
5·	290	640	350	25·3	50·0	1·829	1·976	380	500	120	26·3	104·9	4·166	3·988
4·5	350	820	470	24·1	50·8	1·745	2·108	520	660	140	26·1	105·7	4·714	4·049
4·	480	1080	600	33·6	51·8	1·800	2·195	710	880	170	26·3	106·5	5·176	4·049
3·5	650	1400	750	22·7	52·4	1·866	2·308	1080	1340	260	26·3	107·2	5·154	4·076
3·	880	1900	1020					1650						

IX.—*Table showing the rates of descent, velocity, resistance to sinker and line, and weight of line in water, from observations made by Lieut. Comm. Joseph Dayman, R. N. Diameter of line 2 inches. Specific gravity 1·3. Weight 96 pounds.*

Depth.	Intervals of Times of Descent.	Velocity.	Resistance to Sinker.	Resistance to Line.	Weight of Line in Water.
Fathoms.	Min. Sec.	Feet.	Pounds.	Pounds.	Pounds
0		27·26	82·0		
100	1 24	7·14	5·62	100·6	23
200	1 17	4·35	4·33	119·4	46
300	2 01	.....	4·33	138·1	69
400	2 07	.....	.....	156·8	92
500	2 20	.....	.....	175·5	115
600	2 18	.....	.....	194·2	138
700	.....	.....	.....	212·9	161
800	.....	.....	.....	231·6	184
900	.....	.....	.....	250·3	207

TABLE IX. (Continued.)

Depth.	Intervals of Times of Descent.	Velocity.	Resistance to Sinker.	Resistance to Line.	Weight of Line in Water.
Fathoms.	Min. Sec.	Feet.	Pounds.	Pounds.	Pounds.
1000	.....	.....	.....	269·0	230
1100	.....	.....	.....	287·7	253
1200	.....	.....	.....	296·4	276
1300	.....	.....	.....	325·1	299
1400	.....	.....	.....	343·8	322
1500	.....	.....	.....	362·5	345
1600	.....	.....	.....	381·2	368
1700	.....	.....	.....	399·9	391
1800	.....	.....	.....	418·6	414
1900	.....	.....	.....	437·3	437

ART. XVIII.—*On an Earthquake in Western New York;* by C. E. WEST.

AN earthquake was felt in Western New York, on the 23d of October last. The following pages contain such statistics respecting it, as have come to my knowledge.

It occurred in Buffalo, at a quarter past 3 o'clock, P. M., and was violent, compared with other earthquakes in the Northern States. I was seated in a chair with my head leaning against the mantle of the fireplace, when the shock occurred, and so great was its violence, as to throw me forward to my feet. My first impression was that the chimney had fallen. I hastened into the street to see if that were the case, and found that others had left their houses for a similar reason. A young lady belonging to my family was standing by the wall of the rotunda—which is built of stone and is some sixty feet high,—and so strong was her impression that the wall was falling, she rushed out of the place in great fear.

The principal of one of our public schools informs me, that he was in the third story of the school house at the time; that the walls vibrated for a minute, and that the vibration increased and diminished, then increased and diminished. The supreme court of the city was in session, and so great was the alarm produced by the shock that most of the persons in attendance left in great haste. A mechanic who was present said that the walls swayed four inches from a vertical line. A person walking in the street remarked that the noise produced by the shock seemed to him like the dumping of coal upon the pavement. Another resident of the city said the roar seemed as though it were produced by a multitude of carriages rapidly driven under ground. It appeared to him to come from the northeast and pass to the southwest.

Many examples of a similar character might be given to show the nature of this earthquake, as experienced by the inhabitants of Buffalo, but sufficient have been cited for our purpose. Houses were shaken, door bells were rung, crockery rattled upon the shelves, the people were alarmed.

I have received communications from persons living in neighboring towns, which will aid us in tracing the character and extent of the earthquake wave. The shock was generally severe throughout this county. Farmers at work in the fields were much alarmed. An interesting fact is related of a farmer living in Aurora, a town 16 miles S.E. of Buffalo. He was digging potatoes in his field, at the time of the earthquake, and so powerful was the shock, that he instinctively leaned upon his hoe-handle, and while in this posture, he observed the dirt shake back and forth over the top of the hoe, which was partially buried in the soil.

J. Henning, Esq., editor of one of the Toronto, C. W. papers, writes, "In reply to your note of yesterday, enquiring respecting the supposed shock of an earthquake in Toronto on the 23d Oct. last, I may say, that I have been unable to find any one who felt such a shock. Indeed, I do not think that it came in the direction of this City; but extended in a line through Buffalo and the central portions of the State of New York. It is said that it was experienced sensibly in Hamilton, (C. W.) at 3 o'clock, P. M.; that there were two distinct shocks at intervals of ten seconds accompanied with a rumbling noise. This is possible; as it was also felt in another portion of the same ridge of hills at Queenstown. In Port Hope and Peterboro' it was felt, or I am inclined to think, fancied to be felt, by some parties. There was no mention of it in those places until after the account of its visit to Buffalo was published. After its tricks in the latter city, several other localities claimed the honor of a visit. I think on the whole, the Hamilton hills bounded its progress in our direction, still I may be in error."

Rev. Mr. Cook of Lewiston writes, "It occurred here at the same time as in Buffalo. The noise was very distinct, as of a train of cars; and the motion was such as to cause a perceptible undulation in our dwellings, and to make dishes and stoves rattle audibly. The same phenomena attended its appearance at about the same time at St. Catharines, twelve miles west of this."

Judge Dayton of Lockport, writes, "The earthquake on the 23d of Oct. was felt here very sensibly, though probably less so than at Buffalo. I was myself in the cars between Lockport and Niagara Falls at the time, and of course did not notice it. At the County Clerk's office in this village, it is said to have been preceded by a low rumbling noise not unlike the heavy rumbling of a train of cars approaching from a distance. The

sound came from the West; and as it approached increased, though still dull and heavy, and was accompanied with a perceptible motion of the walls of the building, a shaking of the windows, and a distinct vibratory motion was given to the chandeliers suspended in the office. The general impression seemed to be that the shock lasted about a minute, though there is nothing reliable in that particular. Probably the time was less than that, as there seems to have been no repetition of the shock. At my house which is a mile and a half distant, the observations made by my family were very similar to those made at the Clerk's office. There was a distinct rattling of the windows.

Some in the village described the noise as like that made by the echo following the discharge of a cannon. It is generally understood that it occurred a little after three o'clock in the afternoon. I can find no one, however, who was particular to note the time."

"At Pendleton about five miles southwest of this, the observations made were the same as at this place, in regard to the shock and its accompaniments. My informant says it occurred there precisely at 3 o'clock."

"It may not be amiss to state that we had another shock here in the early part of January (1858) about ten or eleven P. M. It was slighter than that in Oct., and was accompanied by the same dull, heavy, rumbling sound, and a perceptible shaking of windows, doors, &c. I was partly asleep at the time, but thoroughly aroused by the same."

Prof. Dewey of Rochester University, writes, "I have no information to give. The earthquake was distinct at Lockport about $3\frac{1}{2}$ o'clock P. M. It was noticed at Medina I heard, and at Batavia, as well as at Brockport. It was said to have been noticed here, but I could not find any clear evidence of the fact."

The Principal of the Brockport Collegiate Institute, writes, "The shock of an earthquake was very sensibly felt here on the 23d of Oct. last by many persons."

Rev. Dr. Samuel H. Cox, Chancellor of Ingham University, at Leroy, N. Y., writes, "In relation to your inquiry touching the earthquake, said to have occurred in all this region, on Friday, Oct. 23d, 1857, I can only say, not from my own consciousness, or memory, but from the concurrent testimony of many others, that a sensible terra motus was realized here and in many other places, on that afternoon.

Several of the young ladies of the University, some then at houses in the vicinity, declare their sensations at the time, all taking notice of it. One of them says, 'I was at the piano playing alone. The shock made the windows rattle and was repeated after a few moments.'

A very intelligent lady in my immediate neighborhood told me distinctly as follows: 'I well recollect it, I was sewing quietly in my chamber, when the shaking of the house alarmed me; the windows rattled; the reality of it was certain. I descended to the kitchen and asked my cook if she knew what was the matter, she replied yes ma'am, it thundered.'

An educated and excellent friend of mine at Avon, near us, about 14 or 15 miles east by south of my residence says, 'yes, I felt it—I was reclining on my bed at the time. The whole house shook so alarmingly that I arose, went down and compared notes with others. We all felt it and recognized it as a veritable earthquake.'"

Rev. E. S. Wright of Fredonia, Chautauque Co., N. Y., 40 miles S.W. of Buffalo, writes, "the earthquake to which you allude, I should think, was felt in this village, about half past 3 o'clock on the 23d of Oct. last; at least, somewhere between fifteen and thirty minutes past three P. M. At the time, I was conversing with a deacon of my church, a short distance from the village, who was husking corn in his barn. The sound was a rumbling noise, approaching slowly and loudly like the heavy wheels of a loaded wagon, in the road. The noise continued about the length of time in which a wagon would be passing the barn pretty rapidly with a load. Mrs. Wright says she was aroused by a sudden noise as if my book-case had been struck by a person falling against it in a chair. Soon the house seemed to rise and sink a little, and all was over. The earthquake was felt similarly throughout the place, I believe."

Rev. Charles F. Massey, of Westfield, Chautauque Co., N. Y., 57 miles W.S.W. of Buffalo, informs me that the shock was felt in that village.

C. D. Sacket, Esq., Editor of the Jamestown Journal, Jamestown, Chautauque Co., N. Y., S W. of Westfield, writes, "The shock of an earthquake was distinctly felt at this place and at Warren, Pa., (20 miles south) at 3 to 4 o'clock P. M. The character of the phenomenon was first a shock and then a vibration of the ground. Stoves and windows shook. My wife, on a visit at Westfield, N. Y., heard a sound, as if the cars were approaching the house, though the road was half a mile off. It was noticed by our citizens generally. Dr. Parker of the water-cure here, was reclining on a sofa, reading, when he felt a jar and heard a sound, as if some one had jumped from quite a height to the floor in the hall. The effect did not seem to continue more than a moment or two."

Rev. C. L. Hequembourg of Warren, Pa., a town situated on the Alleghany River, about 120 miles N.N.E. of Pittsburg, writes, "Several persons felt the shock here, and it was also felt at Sugar Grove, (15 miles N.W. of Warren). It was felt so slightly

here that very few facts could be ascertained in regard to its direction, &c. My impression is that the movement was from S.E. to N.W., perhaps the reverse. The time, if I recollect right, was a little earlier in the afternoon than you mention. The shock appears to be of a local character, confined to this region only. It is worthy of remark that the shock was preceded by a series of rains, such as had not been known before in this section of country for many years. I should think the movement was horizontal only, but as to whether it radiated, and where the centre was, I can give you no information. Perhaps it was altogether linear. . . . . When I felt the shock to which you refer, I was sitting in my study writing; I thought some one was moving violently upon the lower floor; but listening, found it was not the case. In a few seconds I felt another shock, and if I remember right, there may have been a third. I felt satisfied on the second or third movement that it was an earthquake. In connection with one of the shocks, I heard a noise as well as felt a movement or shaking of the house.

At Hinsdale, Cattaraugus Co., N. Y., which is not many miles east of Jamestown, there was no earthquake felt on the 23d of Oct., as I learn from a correspondent—an important fact to be borne in mind by the reader.

Rev. William S. Plumer, D.D., of Alleghany, Pa., opposite Pittsburg, writes, "I have no recollection of feeling any earthquake here during the month of October last; nor do I remember to have heard any one speak of it."

Prof. Smith of Jefferson College, Canonsburg, Pa., 20 miles from Pittsburg, writes, "I can only say that no shock of an earthquake was felt in this region at the time alluded to in your letter. Nor was there any thing indicating that there was such a thing in this region. I am in the habit of recording all the atmospheric and other phenomena that fall under my observation, and I would not have failed to notice and record the time and circumstances of an earthquake, if it had been perceptible here. I have enquired of several persons, both in the town and country, but was unable to procure any information on this subject."

A correspondent from Erie, Pa., 90 miles S.W. of Buffalo, writes, "It was felt in various parts of the city, both north and south of us—houses were shaken and the sound was like a heavy wagon passing over frozen ground."

Wm. L. Perkins, Esq., of Painesville, Ohio, on the railroad from Erie to Cleveland, writes, "I have made diligent enquiry, and referred also to the files of the two village newspapers here, but have no recollection, and find no mention of an earthquake here, on the 23d of Oct. last, or about that time..... We have, within about a year past, experienced two, and it seems to

me, three earthquake shocks here. The first, and by far the most energetic, was on the last day of Feb. 1857, I think in the evening. The last was on the 16th of April, 1858, about 6 o'clock, A. M.

F. J. Prentiss, Esq., of Cleveland, Ohio, writes, "I have made repeated and thorough enquiries with reference to the earthquake of which you speak, and am satisfied that it was not known or felt in this part of the State. Within a few weeks past, two shocks were felt in this city, at Painesville and Ashtabula, but I can find no one who knows anything about an earthquake in Oct. last."

Hon. David Campbell of Sandusky, Ohio, writes, "I have made enquiries in relation to the earthquake, but have not heard that it was observed anywhere west of Westfield, N. Y.

From the facts submitted the following inferences may be drawn:

1. That the maximum intensity of this earthquake was felt in Buffalo and its vicinity.

2. That its undulations were propagated in a linear direction, passing through Port Hope, Lockport, Buffalo, Jamestown and Warren, which lie on an arc of a great circle, varying but little from a north and south line.

3. That its intensity diminished on either side of this line, nearly subsiding at Hamilton on the west, and entirely so at Rochester and Hinsdale on the east.

4. That the limits of this line were Port Hope, C. W., which is situated on Lake Ontario, and some point south of Warren, Pa.

Art. XIX.—*The Rocks of Kansas;* by Prof. G. C. Swallow of Missouri.

(Read before the American Association for the Advancement of Science, at Baltimore, 1858.)

At the last meeting of the American Association at Montreal, I presented a geological map of Eastern and Central Kansas. The Eastern portion was colored according to the facts derived from my own personal observations; but the geology of Central Kansas was laid down according to data derived from other geologists, the greater part from Maj. Hawn. At that time I had seen no fossils from the rocks laid down as Lower Carboniferous according to the opinions of other geologists; but the fossils since collected by Maj. Hawn clearly prove a portion of those rocks to belong to the Permian age. There are however some beds between the well characterized Permian strata and the Cretaceous from which only a few imperfect fossils have been ob-

tained. And those few imperfect forms seem to have various affinities; some to the *Triassic*, some to the *Liassic* and others still to the *Jurassic*.

My means of comparing the fossils of the three systems last named, are limited, and I would solicit the criticism of those who have had better opportunities for deciding the age of these doubtful rocks between the Cretaceous and Permian.

I am indebted to Maj. Hawn for nearly all the information presented in the accompanying map and section of the rocks of Kansas.

Section of the Rocks of Kansas by Maj. F. Hawn.

SYSTEM I.—QUATERNARY.

No. 1—150 feet Bluff, the same as in Missouri—2d Ann. Rep. Missouri Survey.
" 2— 4 feet white clay—2d Ann. Rep. of Missouri Survey.
" 3— 15 feet local drift.

169 feet of Quaternary.

SYSTEM II.—CRETACEOUS.

No. 4—45 feet light gray crystalline limestone.
" 5—27 feet slope strewn with light gray calcareous concretions.

72 feet of Cretaceous.

SYSTEM III.—TRIASSIC. (?)*

No. 6—12 feet light gray arenaceous limestone.
" 7—10 feet blue pyritiferous clay.
" 8—15 feet dark brown ferruginous sandstone.
" 9— 8 feet, like No. 7.
" 10—18 feet flesh-colored quartzitic sandstone.
" 11—14 feet variegated, red and white, clay.
" 12—8½ feet white granular gypsum. (Local.)
" 13—12 feet, like Nos. 7 and 9.
" 14—20 feet dark brown ferruginous sandstone.
" 15—13 feet variegated, white and red, clay.
" 16—50 feet soft, coarse, buff sandstone.
" 17—30 feet pyritiferous clay.
" 18—10 feet yellowish brown argillaceous sandstone.
" 19—10 feet thin silico-calcareous strata, containing fragments of trees.
" 20— 3 feet brown impure lignite.
" 21—10 feet black pyritiferous clay, containing numerous stellated crystals of selenite.
" 22—60 feet gray, blue and brown clay, with thin seams of fibrous selenite, and flesh-colored nodules of gypsum.
" 23—75 feet soft, crumbling brick-red sandstone.
" 24—17 feet white clay, with soft concretions of oxyd of iron.
" 25—15 feet conglomerate of coarse sand and small brown pebbles.

420½ feet of Triassic. (?)

* All we mean by this is that these beds are between the *Cretaceous* and the *Permian*. Some of the fossils from these beds seem to be *Triassic*, others *Liassic*, and one probably *Jurassic*.

SYSTEM IV.—PERMIAN.

UPPER PERMIAN.

No. 26—100 feet brown and yellow, cellular and brecciated limestone, alternating with brown, blue and white pyritiferous clay, containing a bed of white granular gypsum, 5 feet thick.

" 27—18 feet conglomerate, of angular, water-worn fragments of limestone, cemented with white argillaceous matter. This bed is local, and may not have its true position.

" 28—15 feet, resembling No. 26, but more compact.

" 29—60 feet dark brown, silicious limestone, alternating with coarse, impure, brown clays, containing crystals of chalcedony and agatized quartz.

" 30—25 feet dark buff, compact limestone.

" 31—45 feet red clay.

LOWER PERMIAN.

No. 32—25 feet brown shale, containing geodes whose drusy cavities are filled with crystals of quartz, and reniform nodules of variegated white and red quartz, often agatized.

" 33—30 feet gray limestone and flint, with beds of brown clay.

" 34—25 feet massive, cherty, magnesian limestone and brown clay; the lower magnesian beds contain angular fragments of jasper.

" 35—20 feet of brown clay, fossiliferous.

" 36—18 feet red clay.

" 37—60 feet silicious, yellow, magnesian limestone, with heavy beds of brown clay.

" 38—10 feet massive bed of flint and limestone.

" 39—25 feet gray and yellow limestone, containing small globular and pear-shaped nodules of chert, and geodes with crystals, alternating with beds of brown and blue clay.

" 40—75 feet brown magnesian limestone, alternating with beds of brown, olive-green and red clays.

" 41—25 feet light buff amygdaloidal magnesian limestone and chert.

" 42— 8 feet heavy-bedded yellow, magnesian limestone.

" 43— 3 feet blue fossiliferous slate.

" 44—15 feet brown slate.

" 45—10 feet brilliant yellow, magnesian limestone.

" 46—17 feet dark brown limestone, with numerous joints of large *crinoidal* columns.

" 47— 4 feet light yellow silicious limestone.

" 48—30 feet red clay.

" 49— 8 feet silico-calcareous slate.

" 50— 5 feet olive-green clay.

" 51— 4 feet red clay.

" 52—10 feet dark gray limestone.

" 53— 6 feet olive-green slate.

" 54— 8 feet dark-blue slate.

" 55— 6 feet bluff limestone.

" 56—16 feet brown slate.

" 57— 3 feet dark blue slate.

" 58—13 feet gray clay.

" 59— 3 feet compact, light buff limestone.

" 60— 5 feet brown clay.

" 61—15 feet blue shale, fossiliferous.

" 62— 3 feet compact, drab, silicious limestone, with small nodules of chert.

" 63— 4 feet brown limestone.

" 64— 3 feet soft, light brown clay.

" 65—15 feet soft, olive-green clay, with a band of red clay, one foot thick.

" 66— 4 feet gray oolitic limestone.

" 67— 4 feet bright olive-green clay.

No. 68— 6 feet dark, buff, oolitic limestone.
" 69— 5 feet dark blue slate.
" 70— 7 feet drab limestone.

Total, 820 feet of Permian Rocks.

SYSTEM V.—CARBONIFEROUS.

1073 feet coal measures, a continuation of, and probably above, the Upper Coal Series of Missouri. (See 2d Missouri Rep., Part I., p. 78.)
170 feet of Lower Carboniferous.

Catalogue of Fossils mainly from the Permian Rocks of Kansas.

NAMES OF SPECIES.	*Coal Measures.*	*Lower Permian.*	*Upper Permian.*	*Triassic (?).*	LOCALITIES.
[A trilobate leaf of an unknown exogenous plant,	..	..	..	*	No. 14 (?) of the foregoing section.
Stenopora crassa, *Lonsdale.*	..	*	..	..	Valley of Cotton-wood.
" spinigera, *Lonsdale.*	..	*	..	..	Rock Creek, Santa Fé road.
Chætetes, three species (*undetermined*).	..	*?	..	..	Valley of Kansas, west of Fort Riley.
Fenestella flabellata (?) *Phillips.*	..	*	..	..	Near Council Grove.
Synocladia virgulacea (?) *King.*	..	*	..	..	Valley of Cotton-wood.
Thamniscus dubius, *Schlotheim.*	..	*	..	..	" " " "
Acanthocladia anceps (?) *Schlotheim.*	..	*	..	..	Near Hay's Ranch.
Phyllopora Ehrenbergi, *Geinitz.*	..	*	..	..	Valley of Cotton-wood.
Archæocidaris Verneuiliana, *King.*	..	*	..	..	Near Lost Spring, S. Fé road.
Cyathocrinus ramosus (?) *King.*	..	*	..	..	Near Council Grove.
Serpula (Spirorbis) valvata, *Goldfuss.*	..	*	*	..	Near Smoky-Hill Fork.
Spirorbis orbiculostoma, *Swallow.*	..	*	..	..	Valley of Cotton-wood.
Phillipsia, *species not determined.*	..	*	..	..	Near Council Grove.
Productus Calhounianus, *Swallow.*	..	*	..	..	Valley of Cotton-wood.
" semireticulatus, *Martin.*	*	*	..	..	" " " "
" Rogersii, *Norwood & Pratten.*	*	*	..	..	South Fork Cotton-wood.
" æquicostatus, *Shumard.*	*	*	..	..	Valley of Kansas, W. Ft. Riley
" Norwoodii, *Swallow.*	..	*	..	..	Valley of Cotton-wood.
Spirifer cameratus, *Morton.*	*	*	..	..	Rock Creek, Santa Fé road.
" planoconvexa, *Shumard.*	*	*	..	..	Valley of Cotton-wood.
" pectinifera (?) *Sowerby.*	*	*	..	..	Valley of Big Blue.
Chonetes Flemingii, *Norwood & Pratten.*	*	*	..	..	Near Council Grove.
Orthisina umbraculum, *Buch.*	*	*	..	..	Generally diffused.
" Shumardiana, *Swallow.*	..	*	..	..	Red Water and Cotton-wood.
" Missouriensis, *Swallow.*	*	*	..	..	Red Water.
Rhynchonella Osagensis, *Swallow.*	*	*	..	..	Valley of Big Blue River.
Terebratula (?) subtilita, *Hall.*	*	*	..	..	Generally diffused.
Monotis speluncaria (?) *Schlotheim.*	..	*	..	..	
" " var. Americana, *Swallow.*	..	..	*	..	Near Smoky-Hill Fork.
" radialis, *Phillips.*	..	..	*	..	" " " "
" variabilis, *Swallow.*	..	..	*	..	Valley of Cotton-wood.
" Halli, *Swallow.*	..	*	*	..	" " " "
Avicula gryphæata (?) *Munster.*	..	..	*	..	Near Smoky-Hill Fork.
Pecten Cleavelandicus, *Swallow.*	..	*	..	..	Valley of Cotton-wood.
" ringens, *Swallow.*	..	*	..	..	" " " "
" acutialatus, *Swallow.*	..	*	..	..	Valley of Kansas.
Mytilus (Myalina) Permianus, *Swallow.*	..	..	*	..	" " "
" " concavus, *Swallow.*	..	..	*	..	White Water.

NAMES OF SPECIES.	*Coal Measures.*	*Lower Permian.*	*Upper Permian.*	*Triassic (?).*	LOCALITIES.
Mytilus (Myalina) squamosus, *Sowerby.*	..	*	..	..	Valley of Cotton-wood.
" " rectus, *Shumard.*	*	*	..	..	Valley of Verdigris.
Myalina subquadrata, *Shumard.*	*	*	..	..	" " "
" Kansasensis, *Shumard.*	*	*	..	..	Near Council Grove.
Bakevellia antiqua, *Munster.*	..	..	*	..	Valley of Kansas.
" pulchra, *Swallow.*	..	*	..	..	" " "
Edmondia gibbosa, *Swallow.*	..	*	..	..	Valley of Cotton-wood.
" Otoensis, *Swallow.*	..	*	..	..	" " " "
" semiorbiculata, *Swallow.*	..	*	..	..	Council Grove.
Nucula (Leda) Kazanensis, *Vern.*	..	*	..	..	Valley of Cotton-wood.
" speciosa (?) *Munster.*	..	..	..	*	No. 18 of foregoing section.
" (*species not determined*).					
Solemya biarmica (?) *Verneuil.*	..	*	..	..	Valley of Kansas.
" (*species undetermined*).	..	..	*	..	Smoky-Hill Fork.
Solen (?) Permianus, *Swallow.*	..	..	*	..	" " "
Cardiomorpha rhomboidea, *Swallow.*	..	*	..	..	Council Grove.
" Kansasensis, *Swallow.*	..	*	..	..	Valley of Cotton-wood.
Cardinia cordata, *Swallow.*	..	*	..	..	" " " "
" subangulata, *Swallow.*	..	*	..	..	" " " "
Cardina (*species undetermined*).					
" Listeri (?) *Sowerby.*	..	..	..	..	
Pleurophorus (?) Permianus, *Swallow.*	..	*	..	..	Smoky-Hill Fork.
Schizodus obscurus, *Sowerby.*	*	*	..	..	Valley of Cotton-wood.
" triangularis, *Swallow.*	..	*	..	..	" " " "
" Rossicus, *Verneuil.*	..	..	*	..	Smoky-Hill Fork.
Lyriodon (Myophoria) orbiculare, *Goldf.*	..	..	..	*	No. 18 foregoing section.
Allorisma lanceolata, *Swallow.*	..	*	..	..	Near Council Grove.
" curta, *Swallow.*	..	*	..	..	" " "
" Minnahaha, *Swallow.*	*	*	..	..	" " "
Murchisonia subangulata (?) *Vern.*	..	..	*	..	No. 26 foregoing section.
" Kansasensis, *Swallow.*	..	*	..	..	Valley of Cotton-wood.
" perversa, *Swallow.*	..	*	..	..	" " " "
Loxonema fasciata, *King.*	..	*	..	..	Valley of Kansas.
Macrocheilus spiratus, *McCoy.*	..	*	..	..	" " "
Naticopsis Pricei, *Shumard.*	*	*	..	..	" " "
Nautilus Permianus, *Swallow.*	..	..	*	..	Smoky-Hill Fork.
" occidentalis, *Swallow.*	..	..	..	..	Valley of Cotton-wood.
Orthoceras Kickapooense, *Swallow.*	..	..	*	..	Smoky-Hill Fork.
Cyrtoceras dorsatum, *Swallow.*	..	..	*	..	" " "

As it appears from this section there is scarcely any perceptible change in the lithological character of the strata in passing from the Coal Measures to the Permian* beds; but the appearance at this point of numerous new fossils, many of which are well known Permian types of the genera *Monotis*, *Bakevellia*, *Schizodus*, *Pleurophorus*, *Synocladia* and *Thamniscus*, clearly indicate the introduction of the Permian age.

* So far as known, there is no want of conformability between these systems (?); but this seems to be no proof that there is no change of systems. Nonconformability is a proof of change; but conformability is no proof of the absence of a change.

In the strata which are marked Lower Permian, Maj. Hawn collected sixteen species of fossils found in the Coal Measures, and forty-one species not seen below the Permian. Nearly all of the forty-one species are Permian types, and sixteen of them seem to be identical with well known European species. In the Upper Permian there are sixteen Permian species and only *one* Carboniferous, *Terebratula subtilita*. So that in all of these beds there are fifty-seven species of Permian fossils and only sixteen Carboniferous; and yet, although the Permian *species* are so much more numerous, the Carboniferous *specimens* are much more abundant, about as ten to one of the Permian forms.

Of these Permian fossils I have described thirty-four new species and Mr. Meek ten.

In an economical point of view, these Permian beds are very important. The gypsum they contain, will enable the farmer to convert the vast sandy plains of Central Kansas into the most productive regions of the West and fill the wilderness with a teeming happy people. It will also supply the commercial demands of the Mississippi valley, which are now met by importation.

Note.—There has been some misunderstanding in relation to the Permian fossils of Kansas. This has all arisen, as I apprehend, from a misunderstanding of the arrangement between Maj. Hawn and Mr. Meek. It may be proper to state in this place, where all the parties interested are represented, the facts as they exist.

Since the first announcement of the discovery of Permian Rocks in Kansas, in the March number of the Journal of Science, several communications have appeared in rapid succession disclosing the existence of that formation in various parts of the West.

My paper declaring the discovery of several well known Permian fossils in the valley of the Cotton-wood in Kansas, was read in the St. Louis Academy of Sciences on the 22d of Feb. On the 2d of March, Messrs. Meek and Hayden announced the discovery of Permian fossils by Maj. Hawn on the Smokey-Hill Fork in Kansas, and by Dr. Cooper near Helena in the same Territory, in the Albany Institute. On the same day, their announcement was read in the Academy of Natural Sciences at Philadelphia.

On the 8th of March Dr. B. F. Shumard announced the discovery of Permian Rocks by Dr. G. G. Shumard in the Guadaloupe mountains in New Mexico.

Dr. Norwood's letter showing the existence of Permian Rocks in Bureau, La Salle, and Henry counties in Illinois, was read in the St. Louis Academy on the 5th of April.

Since these announcements were made, Prof. Hall has informed me that he has determined the existence of Permian Rocks in Iowa and Illinois.

It is but just to state in this connection, that so far as I know, Mr. Meek first discovered the Permian character of the Kansas fossils, and communicated to Maj. Hawn his impressions* on the 3d of Sept. 1857. He also mentioned his discovery, as I am informed, to some friends at the Smithsonian Institution on the 17th of January, 1858, and communicated the same to Prof. Leidy on the 16th of March.

Maj. Hawn frankly declares, that his first impressions that the rocks in question might be Permian are due to Mr. Meek.

Such are the facts as I understand them. If I am wrong, let the correction now be made. If any one knows anything contrary to these statements he will confer a favor by making it known at this time.

Art. XX.—*Contributions to Analytical Chemistry;* by Henry Wurtz, of New York City.

1. *On the Action of Nitric Acid in the cold upon some Metallic Solutions, with new modes of obtaining pure Compounds of Barium, Strontium, and Cadmium.*

(Read before the American Association for the Advancement of Science, at Baltimore, 1858.)

In the course of the investigation which forms the subject of a previous paper, on the action of hot nitric acid on the chlorids, in the last number of this Journal, it will be observed that nitric acid was found to have also a powerful decomposing action upon some chlorids at the ordinary temperature; and this observation has rendered imperative the commencement of a complete examination of its action upon *all* the chlorids in the cold. This examination is in progress, but some of the results already obtained being of important practical value, I take this opportunity of making them known without delay, in the form of a brief preliminary notice.

To each chlorid in concentrated solution was added twice its volume, or more, of strong nitric acid. With the chlorids of barium and cadmium were obtained immediately granular crystalline precipitates, so voluminous that unless too much nitric

* This communication to Major Hawn was in the following language:—"The fossils from Smokey Hill are of a rather suspicious character, that is, they lead me to think these beds may be, after all, *Triassic* or *Permian*, though they may belong to the Upper Coal Measures."

acid is added, the liquid becomes almost solid. With chlorid of strontium the precipitate is more slowly obtained. In each case, the precipitate, after being rinsed two or three times with pure nitric acid and dried upon porous earthenware, was entirely composed of nitrate without any chlorid. A solution of corrosive sublimate gave also by the same treatment a large crystalline precipitate, which appeared, however, to be chlorid and not nitrate of mercury.

The chlorids of potassium and sodium did not give immediate precipitates, but on standing for a few hours in the cold, crops of large crystals were obtained, which were easily recognized as nitrates. The liquid poured off from these crystals gave, on addition of alcohol, further crystalline precipitates of nitrates of potash and soda.

Experiments with the chlorids of calcium, magnesium, cobalt, nickel, zinc, copper, and ammonium, protochlorids of iron and tin, bichlorid of platinum and sesquichlorid of chromium have as yet given no results, but are to be repeated, with modifications. Mitscherlich states* that *nitrate of lime* "is precipitated from its aqueous solution by concentrated nitric acid as a crystalline powder."

The precipitation of solutions of the three metals first mentioned, barium, strontium, and cadmium, by strong nitric acid, which under favorable conditions I find to be almost perfectly complete, the supernatant liquid retaining but traces of the base, occurs to me as capable of being made use of practically in important ways. It may be doubted whether any method was ever heretofore devised by which barium and strontium compounds, particularly the latter, can be obtained perfectly free from lime, or cadmium compounds perfectly free from lead, tin, antimony, etc. This behavior with nitric acid, however, furnishes us at once with the means of accomplishing these desiderata, as the nitrates of the contaminating bases, being present in very small quantities, must remain in solution in the excess of nitric acid. Nitric acid which has been employed for such precipitations is for many uses as good as before, and may be purified by simple distillation, or concentrated by evaporation and used again for the same purpose.

It is unnecessary to do more than allude to the importance of our being able to obtain compounds of these metals perfectly pure—in the determination of their equivalent weights, for instance.

The chlorids of barium and strontium are precipitated by muriatic acid, as well as by nitric; so that when pure chlorids are

* Gm. Handbuch, ii, 212.

required instead of nitrates, the former acid may be employed. Chlorid of cadmium, however, seems to be soluble in chlorohydric acid.

2. *On some Improvements in the Preparation of Hard Minerals for Analysis.*

Read before the American Association for the Advancement of Science, at Baltimore, 1858.

NOTHING, it may be asserted, tries the proverbial patience of the chemist more than the preparation of hard minerals for analysis. The following suggestions are therefore offered in the hope that they may be of some small service in lightening this species of unappreciated toil.

The ordinary method of reducing to fine powder by first crushing to coarse powder in a diamond mortar, and then triturating in an agate mortar, is open to several serious objections. In the first place, the diamond mortar, of the usual construction in three pieces, is difficult to manipulate with, and extremely liable to get out of order. Its preservation from *rust*, which immediately destroys its efficiency by causing friction, is almost impossible in the acid atmosphere of a laboratory; and, moreover, the quantity of material that can be operated upon with it at once is very small. An obvious improvement adopted by many chemists, is to use in its stead a *deep* mortar and pestle of the common form, composed of steel, or far better, of *white cast iron*, which besides being harder is less liable to rust. An instrument of this latter description I have used for several years. Another still more serious drawback, however, to this as well as to the diamond mortar, is the inevitable introduction into the powder of more or less *iron* in small particles chipped off by the sharp angles and edges of the fragments crushed. The agate mortar is also objectionable, on account of the very small quantity that must be operated upon at a time, and the contamination of the product with *silica*, proceeding from abrasion of the agate. Some analysts have proposed to overcome this latter objection by *weighing* the agate mortar before and after the operation, to ascertain the quantity of silica ground off, but this involves many impracticabilities, one of which is the necessity, with our ordinary balances, of using a mortar of the smallest size; and the others it is unnecessary to detail.

It has occurred to me therefore, that if the agate were dispensed with entirely, the levigation being completed in the hard white iron mortar, and that if some means could be devised of subsequently removing the abraded metallic iron from the powder, without otherwise affecting the composition of the latter, a step in improvement would have been accomplished. When the mineral contains no ingredient acted upon by *diluted acids*,

the means of effecting this are so obvious that no doubt every analyst has adopted them upon occasion; but the cases in which this occurs are not often met with. Especially when working upon *iron ores*, magnetic, hematitic or silicious, containing *carbonates*, *phosphates*, etc., is the use of acids inadmissible.

We possess, however, agents which while readily dissolving *metallic* iron, are supposed not to act upon its oxyds. *Chlorine water* is such an agent; and in cases where the mineral contains no carbonates, chlorine water may be used without fear of dissolving any *anhydrous* oxyd of iron present. *Limonite*, if present, would undoubtedly be dissolved in small quantity by the sesquichlorid of iron formed. It is scarcely necessary to remark that chlorine water used for this purpose must be freshly made, and made *in the dark*, and kept in the dark before and during the operation, in order that it may contain no acid. Aqueous solution of *bromine*, or still better, of *iodine*, may be substituted for that of chlorine. It was hoped that with iodine water, even minerals containing carbonates might be treated, and in the course of an extensive series of analyses of magnetite ores, (all containing both carbonate and phosphate of lime,) upon which I have been engaged, many trials were made in reference to this point. It was found that even when the experiment was made without access of air, and in the dark, traces of lime were dissolved. In fact it could not be otherwise, for an excess of the solvent being present, sesquiodid of iron must be formed, which is then decomposed by the carbonate of lime. With chlorine water the quantity of lime dissolved was large.

There is another solvent that may be used to accomplish the same purpose as the above, namely, a *neutral* solution of (sublimed) *sesquichlorid of iron*. This is, however, open to the same objections, because while dissolving the metallic iron, it will also dissolve the carbonates and limonite.

It is plain, therefore, that some additional precaution must be contrived before we can attain completely the object proposed. This is fortunately furnished us by the well known power of solutions of ammoniacal salts to dissolve the earthy carbonates when boiled with them. The method then which I at present propose, is to boil a weighed quantity of the powder first with a solution of sal-ammoniac or nitrate of ammonia, until the lime, magnesia, etc., present in the form of carbonates, are dissolved. These are then determined separately, and the remaining powder is treated with iodine water to remove the metallic iron.

Of course the *carbon* contained in the metallic particles will remain, but the quantity of this will be so small that it may usually be neglected.

Other substances, of an oxydable character, may be present in some cases to interfere with complete success, such as metallic

sulphids, and particularly *pyrrhotine.* A portion of pyrrhotine, from the apatite locality near Hurdtown, New Jersey, was digested in fine powder, in the dark, with a brown aqueous solution of iodine (freshly prepared from iodine which had been ground to fine powder and washed repeatedly to remove all free acid) for forty-eight hours. The liquid had then become colorless, and gave a large green precipitate with ammonia, and a black one with sulphid of ammonium. Pulverized *pyrites* treated in the same way did not remove the brown color of the liquid, and the latter had dissolved but a trace of iron.

I must not omit to remark that the iodine solution should not be allowed to stand upon the powder for an unnecessary length of time, especially if air has excess, for in that case a portion of the iron dissolved will sooner or later be deposited again as a basic salt.

Some further suggestions as to details may be acceptable. The mode which I adopt is to reduce the whole mass of substance to be analyzed first to a coarse powder in the white iron mortar, with the aid of a fine sieve in the ordinary way, and then to *elutriate* it (also in the iron mortar) in small quantities at a time, using, however, in this operation, *alcohol* instead of water. I may remark here that water should never be allowed to touch the iron mortar. It should always be washed with *alcohol*, and dried perfectly on the sand-bath after use, thus preserving it from rust. If it should have become rusted internally by exposure to acid vapors, some sand wetted with alcohol should be ground up in it. An acid should never be used to remove the rust, because cast iron (as well as steel) is always more or less *porous*, and a portion of the acid would inevitably be absorbed as a protosalt of iron into the pores, to reappear afterwards as sesquioxyd, or basic sesquisalt, upon the surface.

Art. XXI.—*Chemical Examinations connected with a Bullet which had been Imbedded for more than Forty Years in the Lung of a Man;* by Henry Wurtz, of New York city.

Read before the American Association for the Advancement of Science, at Baltimore, 1858.

While delivering the course on Chemistry in the medical department of Queens College, Kingston, Canada West, during the past winter, the case in question came under my observation, and seemed to me a rare opportunity for a chemical examination of the action undergone by metallic lead when imbedded in a human viscus, and although the examination made, from want of time and other causes, was very imperfect, the results obtained are probably worthy of being recorded. The following history of

the case was drawn up at my request by the gentleman who made the dissection, and found the ball, Dr. Alexander Bethune, now a graduate of the Institution:

William Kelly, act. 76, a pensioner, a native of Ireland, was admitted into the Kingston General Hospital, September 25, 1855. He had *hemiplegia*, and as it was considered incurable he was sent to the House of industry, where he remained only a few days, and then returned to the hospital, in which he continued until the day of his death, December 17, 1857.

Post-mortem appearances: On removing the calvarium more than a pint of bloody serum gushed out. The dura mater was found much thickened and closely adherent. The gray matter of the right hemisphere was softened and contained a clot the size of a pea. The lining membranes of the ventricles were thicker than natural, and they contained serum and organized lymph, with traces of recent inflammation. When the thorax was opened a prominence was observed in the middle lobe of the right lung, and on cutting into it about the depth of an inch, a bullet was found, enclosed in a cyst, and firmly adhering to its wall at several points. On examining the walls of the thorax, a cicatrix was found between the fourth and fifth ribs, corresponding to the prominence produced by the bullet.

In the early part of his life, the deceased had been a soldier in the British army, and was engaged in the Peninsula war. In one of the engagements there he received a wound from a musket ball, which entitled him to a pension. As he was engaged in no war but that of the Peninsula, and had no marks of any other wound upon his body, the bullet found in his lung, more than forty years after, must have been that which produced the wound for which he received a pension.

ALEXANDER BETHUNE.

Queens College, Kingston Feb. 1, 1858.

I may add that the wound is believed to have been received at least as early as the last seige of Badajoz, which occured in the year 1812, and consequently forty-five years ago; and that the hemiplegia was of the right side, or on the same side as the ball.

The ball, as delivered to me, appears to have been a common ounce musket ball, but is irregular in shape, having evidently undergone corrosion. It now weighs 370 grains, indicating a loss, if originally an ounce in weight, of more than one hundred grains. Two spots appeared on opposite sides, where adhesion to the walls of the cyst had existed. These spots are coated with a hard whitish substance, which cuts like horn, and blackens when heated, with a smell of burning animal matter, leaving afterwards an infusible white ash. Near one of these spots was

a small incrustation of a chalky white color, about one-eighth of an inch in diameter, which when detached was found to penetrate somewhat beneath the surface of the lead, and when submitted to careful qualitative analysis, was ascertained to consist wholly of *chlorid of lead*, containing no trace of either phosphoric or sulphuric acid. The ball was then boiled in distilled water and gave a liquid hard to filter clear, which contained considerable chlorid of lead. In places the ball had a very thin brown coating, too small in quantity to be satisfactorily determined, but which was probably also chlorid of lead, colored with organic matter.

A piece cut from the wall of the cyst was treated with chlorohydric acid and chlorate of potash, and the solution examined for lead without success, but the material was so small in quantity that the result is not satisfactory. A piece of the lung itself, taken from the neighborhood of the cyst, was then treated in the same way. The solution obtained gave with sulphohydric acid a small brown precipitate, which was collected on a small *purified* Swedish paper filter, and the latter washed, dried and burned to ashes. The ash, fused with carbonate of soda on charcoal, and manipulated in the ordinary way in the agate mortar, gave a multitude of spangles of a soft white malleable metal, which being collected on a watch-glass, dried, dissolved in a drop of nitric acid and the solution evaporated to dryness, gave with a drop of a solution of sulphohydric acid a deep brown coloration.

I was very desirous to obtain a portion of the *liver*, (which was not yet exposed when I viewed the body,) and left directions that it should be saved, which were unfortunately not complied with, the liver having been thrown among a number of like viscera from other subjects in the dissecting room, so that it could not again be identified. A piece of *muscular tissue*, however, taken from the muscle of the diaphragm, was examined and lead found, apparently in greater quantity than in the lung.

It is evident from these results, that the lead of the bullet has undergone solution in the cyst as chlorid, and passed as such into the circulation, to be deposited again in insoluble forms in other parts of the system, as is usual with the so-called *cumulative poisons*.

The question whether the paralysis and post-mortem appearances had any connection with the presence of the lead, I shall leave for the consideration of medical men and toxicologists.

Art. XXII.—*Suggestions Regarding Economical Applications of Glycerine;* by Henry Wurtz, New York city.

Read before the American Association for the Advancement of Science at Baltimore, 1858.

It must be apparent to every one who considers the peculiar qualities of the substance, glycerine, namely: its resemblance to oils in not being volatile at ordinary temperatures, while, unlike them, it is miscible with water, alcohol, etc.; its resistance to congelation, not being perfectly solid even at the freezing point of mercury;* its unchangeability; its agreeable taste when pure, and harmless action upon the system; its wide range of solvent powers; together with the quantity in which it may be cheaply procured; that it must in future fulfill important purposes, not only in pharmacy, but also in the arts. Accordingly, we find that technical applications have already been proposed for it. Barreswil's method† of preserving clay, which is to be used for moulding purposes, in a moist and plastic state, may be alluded to as an example.

Some uses, which are probably new, have occurred also to me.

In the first place, its conjunction of the property of compatibility with human digestion and assimilation, with that of non-evaporation and even *absorption of water* from the air, suggest applications in the preservation of articles of food and luxury which are injured by desiccation. As an example of minor importance, if *mustard*, for table use, were mixed with diluted glycerine, instead of water or vinegar, the usual vehicles, it would retain its liquidity indefinitely without drying up. So of many other condiments.

A more important application, however, of a similar kind, would be in the preparation of articles of *confectionery* composed of sugar, preserved fruits, chocolate, etc., which are frequently met with enveloped in *tin foil* to prevent their desiccation. The same object might be accomplished more effectually, and probably more economically, by admixture in the process of manufacture with a certain proportion of pure glycerine.

Another article of luxury, of still more extensive consumption, the consumers of which demand that it should be preserved for them in a *moist* state, is that known as "chewing tobacco;" and a vast consumption of tin foil arises from this requirement of the tobacco chewers. I have repeatedly prepared small quantities of chewing tobacco (the variety called "fine cut") for persons addicted to its use, by admixture with a little glycerine, and always very much to their satisfaction. In the preparation of

* Berthelot, in Lieb. and Kopp's Jahresb, 1854, p. 448.
† Nickles' Correspondence in American Journal of Science, (2) xvi, 100.

this drug, the manufacturer must also please the palate of the consumer by introducing some *dulcifyiny* ingredient. Common sugar or molasses, however, will not answer the purpose, because they render the mass liable to ferment and turn sour. An infusion of the root or extract of *liquorice* is therefore usually resorted to. This does not, however, keep the tobacco *moist*, as molasses would do, and to attain this it is necessary to press into solid compact masses and pack into tight cases, or in the case of the finer qualities, to enclose in wrappers of tin foil. In view of these facts, glycerine will be seen to supply every requirement of the tobacconist, as it will not only keep his product *moist* for an indefinite time, even when exposed to the air, but will also *sweeten* it. He may almost look upon glycerine as made specially for his use.

The common *water meters*, used for measuring the consumption of illuminating gas in houses, are open to two strong objections, namely: when in a warm situation the water rapidly *evaporates*, and when in a cold place it *freezes*. To avoid congelation, the usual expedient is to fill the meter in cold weather with *alcohol* or whiskey, thus rendering the first mentioned difficulty, that of evaporation, still more inevitable.

Now what liquid do we possess which is practically free from both these objections of evaporation and congelation? Evidently *diluted glycerine*. I propose, therefore, as a substitute for both water and alcohol for filling gas meters, *glycerine* (sufficiently diluted to prevent its absorption of more water from the gas, and increasing in volume to any important extent), thus rendering the meter independent of attention within the ordinary limits of temperature.

For lubricating the bearings of fine machinery also, and particularly of *chronometers*, glycerine seems to me worthy of a trial, as it is unchangeable by the atmosphere, and remains fluid at temperatures which few or none of the oils will resist. For chronometers, pure *oleine* and *oleic acid* have been used, but the former thickens on exposure to the air,* and the latter congeals at a few degrees below the freezing point of water.†

Other uses occur to me, such as in the preparation of *copying ink*, in *water color painting*, and in the preservation of dried plants for *herbaria* in a flexible state; mere allusions to which may at present be sufficient.

* Loewig's Chem, der organ. Verbind. ii, 511.
† Ibid. ii, 200.

Art. XXIII.—*Examination of the Soluble Basic Sesquisalts*; by John M. Ordway.

It was mentioned in a former communication,* as a proposition likely to prove universally true, that the soluble normal salts of the higher oxyds—that is of those bases containing more than one equivalent of oxygen to one of metal—may be made more or less basic and still remain soluble. In finding out how far this principle arrived at by a partial induction, may apply to particular cases, but little help is to be derived from the recorded labors of others. With regard to this hitherto unheeded matter, the fullest treatises on chemistry give only a few isolated facts; while such works are by no means free from hasty and partial statements, which may not, indeed, be of themselves positively incorrect, but yet are calculated to impart erroneous ideas. Thus Berzelius says under the head of *chlorure aluminique*, "Si l'on ajoute de l'ammoniaque à la dissolution aqueuse de ce sel, mais sans en mettre assez pour que toute l'alumine soit précipitée, il se forme un soussel insoluble." Were this taken to be the whole truth, it would be deemed unnecessary to make further inquiries in that direction, as one would naturally infer that a soluble sub-salt was out of the question; when, in fact, over two-thirds of the acid may be neutralized without permanent precipitation, and the "*soussel insoluble*" is almost the last thing that forms.

The investigation, then, is quite extensive, and must be carried on mostly by special experiments requiring much care, patience, and time. I have thus far been occupied chiefly in examining the salts of the common sesquioxyds, with the primary view of giving more fulness to the history of the sesquinitrates. But the work so expands that its completion must be set forward to a distant day, and in the meantime it may be well to make known some of the facts ascertained, which, from their theoretical and practical bearings, seem entitled to the attention of chemists.

Before taking up the oxyds in detail, it may be remarked, that the soluble compounds, with rare exceptions, appear to be wholly incapable of crystallization. A *gum-like* character is their peculiar distinguishing feature. By spontaneous evaporation they become tough, shining, transparent masses—the less basic of them being again soluble in pure water. Hence when we wish to obtain crystals of the normal salts, an excess of base must be carefully avoided. It must have been from want of attention to this circumstance that some sesquisalts have been described as

* Amer. Jour. Sci., (2) xxiii, 228.

amorphous, which, in reality, admit of very distinct crystallization.

Salts may be made basic in various ways.

The purest and most reliable products are obtained by the method of direct combination; that is by digesting the hydrated oxyds with the normal salts, or with less than the equivalent quantity of acid. And usually the oxyd precipitated from a nitrate is preferable, since the nitrates are the most completely decomposed by alkalies, and therefore afford the purest hydrates. Nor is it altogether a matter of indifference what precipitant is used; for under certain influences most of the sesquioxyds are liable, even in the hydrated condition, to assume an inert allotropic state. For iron, chrome, and cerium, ammonia does well. But to throw down alumina, it is best to use carbonate of ammonia or an alkaline sulphuret.

In the second place, it is sometimes possible by direct oxydation to make a soluble salt with less than the normal quantity of acid. Thus, in cold weather, 2Fe, and $3N.O_5$ may be made to yield NO_2 and $\dot{F}e\ddot{N}_2$. When crystals of protosulphate of iron are put into half their weight of nitric acid of sp. gr. 1, 2, a rapid oxydation ensues, with the evolution of nitric oxyd, and the resulting dark red liquid must contain three equivalents of peroxyd of iron, held in solution by six equivalents of sulphuric acid and one of nitric. Another instance is afforded in the change of protochlorid of tin into a soluble bibasic perchlorid, by means of chlorate of potash.

A third plan, applicable only in some rare cases, is to expel a portion of the acid from a normal salt by a moderate and protracted heating. Nitrate of alumina crystals exposed for several hours to a steam heat, were found to have lost nearly half their acid, the perfectly soluble residue having about the composition $\dot{A}l_3\ddot{N}_5 + \dot{H}_{33}$. A solution of chlorid of aluminium by evaporation to dryness, parted with one-third of its acid without losing its solubility.

Fourthly, we may often operate advantageously by precipitation. A portion of the acid can be removed by another base, in the form of an insoluble salt, and the rest of it may be replaced by another acid in the way of double decomposition. Treated with the proper quantity of carbonate of lead, chlorid of chrome becomes tribasic, and this product gives with acetate of lead, a tribasic acetate of chrome. A tribasic chlorid of aluminium may be neatly and expeditiously prepared by putting with an equivalent of the sulphate, one equivalent of chlorid of barium and two of precipitated carbonate of baryta.

The fifth and easiest way is to neutralize part of the acid of a normal salt by a more powerful base—the whole being left in solution. By this mode the difference between protoxyds and

sesquioxyds is very strikingly illustrated. Thus if we add ammonia to nitrate of zinc, there is a permanent precipitation from the outset. But if weak ammonia be gradually dropped into pernitrate of iron, there is no lasting precipitation, till about seven-eighths of the acid is combined with ammonia. There is a slight opacity induced, even at an early stage of the process, but the liquid becomes quite clear again by standing some hours after each addition of ammonia. The nitrates of chrome and alumina bear less ammonia, but the opacity disappears in a much shorter time. The chlorids behave very much like the nitrates. In analyzing crystals of hydrated chlorid of iron—$Fe_2\,Cl_3\,H_6$—by means of carbonate of baryta, at least three-fourths of the acid was united with the baryta before any ferric oxyd was deposited. The sulphates of iron, chrome, and alumina allow half their acid to be neutralized with ammonia, and the liquid in each case clears itself perfectly in a few moments.

With regard to common alum, this property has long been known, as well as the fact that the pure sesquibasic sulphates of iron, alumina, and chrome, and the bibasic sulphates of zirconia and glucina, are soluble and uncrystallizable. It will be seen from what follows, that it generally requires far more of sulphuric acid than of most others, to keep the sesquioxyds in solution.

Iron.—Peroxyd of iron very rarely performs the office of an acid; it is one of the weakest of the bases, and among all the oxyds of its class it is that which needs the least quantity of acid to dissolve it. This last statement is indeed somewhat parodoxical, for it is well known that a protosalt of iron when oxydized by exposure to the air, lets fall a part of the resulting peroxyd—a fact that has always been dismissed with the very superficial explanation that, as a persalt contains more acid than a protosalt, there is nothing for a part of the newly formed base to combine with.

But it should be noticed that ferric oxyd exhibits quite distinctly the power of existing in two states,—being, in the one, very susceptible of combination, and, in the other, almost devoid of affinity for acids. It is usually in the first condition when it has been precipitated cold by an alkali, from any of its salts. While most of the normal ferric salts, when mixed with a large quantity of water and boiled, deposit an ochrey sediment which is very slow to dissolve in dilute acids,—it being in the same allotropic state as that dropped by a protosalt oxydizing in the air. The various salts differ much in the extent to which they yield to such decomposing and modifying influences. Twenty grams of the crystallized nitrate of iron boiled with about 800 grams of water, gave a light brown precipitate and a liquid almost colorless when cold. The liquid contained all the acid and one-fifth of the iron. The rusty precipitate subsided without

difficulty in the mother liquor, but would not settle at all in the wash water, and as it passed through the pores of the paper, it could not be collected on a filter.

A similar substance forms—even more difficult to settle and collect, and as slowly acted on by acids—when an excess of iron is used to prepare the commercial nitrate.*

A solution containing one per cent of dry perchlorid of iron, became rusty by boiling, but would not settle at all. Yet a small quantity of chlorid of sodium thrown in, effected an immediate separation of the rust, and it was now completely kept back by a filter. The cold supernatant liquor was of a pale yellow color, and retained two-fifths of the iron and six-sevenths of the acid.

Fluorid of iron boiled in 300 parts of water deposited half of its base.

One part of the sulphate,—$\dot{F}e\,\tilde{S}_3\,\dot{H}_9$,—dissolved in 84 parts of water, afforded by thorough boiling, a quickly subsiding precipitate. There remained in the clear, almost colorless liquor, about 57 per cent of the oxyd and 93·5 per cent of the acid. This liquid by boiling with sulphate of soda, suffered a fresh deposition of rust, which, however, disappeared by standing a day or two.

Pure acetate of iron, largely diluted, underwent no change during a thorough and long continued ebullition. Some acetate made by double decomposition from the sulphate, was not at all affected while fresh, but after it had been made some time, heat threw down all the iron, to the last trace, leaving the liquor colorless. Sulphate of soda, without the application of heat, caused most of the oxyd to fall in a few hours.

A solution of the protacetate changes very rapidly by exposure to air, and gives a great quantity of rust.

Why the inert oxyd should form in any case, or why the previous addition of an acid should sometimes prevent its formation, is something that yet remains to be ascertained.

But whatever be the cause, a clear understanding of the fact that the hydrated sesquioxyds may exist in different allotropic states, is of some importance, especially to those concerned in the tinctorial art. It is evident that good success in dyeing can be expected only when the mordants are kept in the active condition throughout all the preliminary operations. In calico print-

* There is no after remedy for trouble of this kind, but to add an excess of nitric acid to the spoiled stuff, and leave it for several weeks or months, till the rust is taken up, and then proceed cautiously with more iron.

But all difficulty may be avoided—as it will be well for dyers to recollect—by using *weighed* quantities of the materials to start with. Thirteen lbs. of iron turnings and 109 lbs. of aquafortis at 32° B. or 57° T., have been found, by frequent trials, to give an excellent product.

ing, a protacetate of iron made with crude pyroligenous acid, is found to answer a better purpose than a purer acetate. Some chemists account for this by saying that the pyrogenous matters prevent the oxydation of the iron from going too far in the drying and aging of the cloth. But granting it to be the magnetic oxyd which goes to make a black dye, it must be admitted that the vegetable principles of the tannin family themselves readily reduce an active peroxyd of iron to the right degree of oxydation; for careful experimenters have proved that the full persalts can be made to give good blacks and purples. The good effects of pyroligneous acid must be owing mainly to its power of preserving the oxyd of iron in the active state. The normal ferric salts are too acid and corrosive to be safely used on cotton; but something might be gained by employing the tribasic pernitrate which is not liable to passivity, and would probably do away or at least shorten the "*aging*" process—there being no acetic acid to get rid of by long exposure.

The polybasic nitrates of iron formed by direct combination, have been already examined, and it was shown that at least eight equivalents of the oxyd might be held in solution by one equivalent of acid. We cannot go quite so far by the method of neutralization, since the basic compounds are less soluble in saline liquids than in pure water. By direct oxydation it is difficult to get beyond a bibasic nitrate. Volatilization of the acid from the crystals by a moderate heat is attended with the formation of a rust.

Perchlorid of iron may be made quite as basic as the nitrate. Berzelius mentions a basic combination, not transparent, obtained by adding the hydrate to a solution of the chlorid, till the former ceases to dissolve. And after saying that *Phillips* give its composition as $Fe_2 Cl_3 + Fe_4$, he expresses a doubt as to the correctness of the analysis, because the solution tried could not have been free from a chlorid of the precipitant. Now time is a very important element in the production of the highly basic compounds. One may easily be deceived as to when the hydrate ceases to be dissolved, and may set down as opaque, that which by longer digestion becomes quite transparent. By successive steps, we get pretty easily as far as $Fe_2 Cl_3 + Fe_{11}$, and in the course of several weeks I have gone as high as $Fe_2 Cl_2 + Fe_{23}$. This product must be free from a "chlorid of the precipitant," since the hydrate was made from the crystallized nitrate, and very thoroughly washed. The liquid thus made is perfectly transparent, though so deep colored that only an exceedingly thin stratum can be seen through. It bears dilution or boiling to any extent; but most saline solutions throw down all the iron. When dried up by spontaneous evaporation, it no longer dissolves

in pure water, while the decabasic and the still more acid compounds do not lose their solubility by drying.

Bromohydric acid takes up at least five equivalents of ferric oxyd.

The iodids form with more reluctance, and have a strong smell of iodine, which becomes weaker, however, as the amount of base increases. By long digestion Fe_5 I.H. was at length formed.

The fluorids make an apparent exception to the general rule, for nothing less than three equivalents of fluorhydric acid would dissolve an equivalent of ferric oxyd; nor could I succeed in making soluble basic fluorids of aluminium or chromium. But this will appear less strange, if we consider that the normal sesquifluorids of these metals are perfectly soluble in water, while most protofluorids will dissolve only in a large excess of fluorhydric acid or in some other acid.

It also requires three equivalents of tartaric acid to take up two of ferric oxyd. And yet acid tartrate of potash dissolves two equivalents of hydrated sesquioxyd of iron, making $Fe_2 \dot{K} \ldots C_8 H_4 O_{10}$.

The sulphite, like the sulphate, can only be made sesquibasic without disturbance.

Carbonic acid has little affinity for sesquioxyd of iron; yet an alkaline bicarbonate may retain it in solution for a time; and it is probably a basic carbonate that is present in this case, and not the mere oxyd, as the old name—"Stahl's alkaline tincture of Mars"—would imply.

The basic acetates are not new. Berzelius says: "L'acide acétique forme, avec l'oxyde ferrique, un soussel soluble, qu'on obtient en dissolvant de l'hydrate ferrique récemment précipité jusqu' à saturation complète dans l'acide acétique. On a ainsi une solution rouge foncée, qui renferme, suivant *Bette*, Fe $\bar{A}c$, et suivant *Janssen*, Fe_2 $\bar{A}c$." Both are right, for the tribasic acetate forms in a day or two, and further solution goes on very slowly; but by several weeks digestion, the sexbasic acetate may be brought to a finished state—and here the saturation seems to be indeed complete. It is not unlikely that as medicinal preparations or as counterpoisons, the nitrates would be preferable to the acetates, since they can be made so much more basic and are less likely to become injured by keeping.

A sexbasic formiate can be made with ease.

Chrome.—Chromic oxyd precipitated by carbonate of ammonia with the aid of heat, has a bluish shade, and is insoluble in weak acids. But the dull green oxyd precipitated cold with caustic ammonia, is usually of the active modification. Chromium falls behind iron in the extent to which its salts can be rendered basic.

The nitrate dissolves enough oxyd of chromium to become octobasic; but as beyond this it does not remain perfectly trans-

parent, it is not easy to tell just how far we can go. In the way of neutralization, more than two-thirds of the acid may be withdrawn, without any permanent loss of transparency. Crystals of nitrate of chrome exposed to a steam heat till they lost 39 per cent of their weight, left a dark green, tough mass, readily soluble in water, and having about the composition $\ddot{C}r\,\dot{N}_2\,\dot{H}_{12}$. By still further heating, the crystals lose more acid and water, and the spongy brittle residue dissolves rapidly in water to a very deep brown liquid, containing chromate of chrome as well as nitrate.

The basic chlorids of chrome are more fluid and clear than the nitrates. One equivalent of chlorhydric acid has been found to take up six equivalents of the hydrate. The acid of the normal chlorid may be neutralized with ammonia till there remains $Cr_2\,Cl_3 + \ddot{C}r_5$; but after this the opacity is very slow in disappearing. From the researches of *Moberg*, it appears that the chlorid maintained for some time at 150° C., becomes sesquibasic and remains soluble.

By the method of direct combination, the iodid and the bromid were, without difficulty, made tribasic.

While the basic chrome salts prepared with the mineral acids, are of a deep green color, the basic acetates and formiates are purple. The acetate may be made tribasic, but it is difficult to go further. The formiate can be made bibasic.

Alumina.—When alumina is thrown down by caustic ammonia in excess, it is very apt to be insoluble in weak acids. In fact it appears to be in the same state as that deposited by a saturated alkaline solution, or that occurring in raw plastic clay.* But if carbonate of ammonia is used, we get a gelatinous precipitate, which, even after drying, readily dissolves in acids, with the aid of heat, carbonic acid being given off. Sulphid of sodium likewise precipitates the earth in the active condition.

Sulphate of alumina cannot, by any mode, be made more than bibasic without becoming turbid.

By direct union, the nitrates, the chlorid, the bromid, and the acetate have been made sexbasic; but here we come to a definite limit. A heat maintained for some time near the boiling point, is needed to finish these combinations. The resulting liquids are very slightly opalescent. They bear dilution and boiling. They are incompatible with sulphates, but allow the addition of nitrates or chlorids.

* In the manufacture of alum by the French method, the alumina is rendered more active by the calcination of the clay. Why exposure to a dull red heat should have such an effect, it is not easy to tell. But as the active state of the earth seems to be induced by the influence of acids, it may be that heating alumina moderately in intimate contact with silicic acid, brings about a change; somewhat as finely divided silica is itself altered by mixing it with lime and burning, for the manufacture of artificial hydraulic cement. Too great a heat, in either case, causes too close a union of acid and base.

In the way of neutralization the chlorid and the nitrate may become nearly sexbasic without any lasting diminution of transparency. A solution of the normal chlorid slowly evaporated to dryness, was found to have left a bibasic residue that dissolved completely in water. Crystals of the nitrate by exposure to a steam heat for thirty-six hours lost half their weight, and the perfectly soluble product consisted of $\dot{Al}_2 \dot{N}_3 \dot{H}_3$.

A tribasic formiate of alumina can be prepared, but it does not keep well.

The acetate suffers only half of its acid to be neutralized with ammonia. More alkali causes it to thicken like starch. This salt parts with most of its acid in drying. If the normal acetate contains any sulphate,—even that of alumina,—boiling renders it opaque.

It is not acetate of alumina, but a solution of the tribasic sulphate in acetic acid, that is used as a mordant for reds in calico printing. And for the brighter tints, this solution is still prepared, as it was in the infancy of science, by partially decomposing alum with acetate of lead—the most expensive way that could be devised. If an aqueous solution of the tribasic muriate or nitrate would answer as good a purpose—and *a priori* there is no reason why it should not do as well or better—it could be made at a much cheaper rate, especially by the alum manufacturer. For such a work the sulphate of alumina liquor made from pipe clay, needs no evaporation nor the addition of potash or ammonia sulphate. Being made quite weak and treated with prussiate of potash, it deposits its iron. The decanted liquor may be treated with sulphuret of sodium in excess, if one has no over sensitive neighbors; if otherwise, carbonate of soda may be used. The well washed and thoroughly drained precipitate being dissolved in a single equivalent of pure muriatic acid, can, for the sake of easy transportation, be dried down by a gentle heat, in stoneware pans, to a spongy, gumlike mass, which easily dissolves in water. Whether this or any more basic salt, actually possesses advantages over the mordant now in common use, it needs some one versed in all the niceties of calico-printing to determine; it lies out of my province. The tribasic chlorid has been tried on cotton by the formula for the madder style, with apparently good results; but experiments made by a novice, and remote from print works, are of little value.

Zirconium.—For want of material, I have been unable to make any examination of the salts of zirconium. But it so happens that there is enough on record so show that they are not unlike those of the other bases of the alumina class.

Berzelius describes a soluble "*sulfate bizirconique*," $\ddot{Zr}_2 \ddot{S}_3$. He also says respecting a sesquibasic chlorid, $2\ddot{Zr}_2 Cl_3 + \ddot{Zr} + \dot{H}_{24}$, "Il se dissout facilement dans l'eau; et en évaporant cette solution

au bain-marie, on obtient le sel à l'etat gommeux. Il se dissout alors lentement, mais complétement, dans l'eau."

Under the head of the nitrates, he further states, on the authority of *Hermann*, "La liqueur peut ensuite dissoudre beaucoup d'hydrate zirconique pour former un soussel soluble dans l'eau. Ou peut aussi, pendant longtemps, ajouter de l'alcali, sans qu'il se forme de précipité."

Zirconia would appear, like the preceding hydrates, to have an inert allotropic form, for we are told that "L'hydrate zirconique précipité des dissolutions de la terre par l'ammoniaque caustique, est une matière blanche volumineuse et demi-gélatineuse, qui se dissout de suite dans les acides tant qu'elle est encore humide, mais qui, apres avoir été lavée à l'eau bouillante ou séchée, n'est plus dissoute que très lentement, même par les acides concentrés."

Cerium.—Ceric oxyd is remarkable for the sparing solubility of its sulphate. The pale sulphur-yellow basic sesquisulphate prepared by Bunsen's method, and not dried, was found to require a very large excess of sulphuric acid for its solution. By treating this acid sulphate with caustic soda, and dissolving the lilac-colored precipitate in a proper quantity of nitric acid, an orange-red, pure, normal nitrate was obtained. This gave with caustic soda or ammonia an oxyd easy to wash and readily soluble in weak nitric or chlorhydric acid; but not in formic, acetic, or fluorhydric acid. The lilac tint of the hydrate is suggestive of didymium, but there could be none present, for, by exposure to the air, the reddish precipitate absorbed carbonic acid and lost its color; and then, too, the basic salts made from it, whether soluble or insoluble, were yellow. The normal salts are mostly orange, and, like the salts of iron, are deeper colored when heated.

By direct union a soluble tribasic nitrate or chlorid can be produced with ease, but a further addition of the hydrate causes the deposition of a yellowish insoluble basic compound. In the way of neutralization, the nitrate, at least, can be made still more basic. It takes up enough carbonate of baryta to abstract five-sixths of the acid, and remains transparent. More of the carbonate causes a complete precipitation.

Ceric oxyd is, very likely, capable of existing in an inert state, but the circumstances under which it assumes such a condition have not been determined. A decided trace of sulphuric acid appears to destroy its activity.

Glucina.—Though glucina had, from its resemblance to alumina, long been reckoned among the sesquioxyds, its claims to such a place have latterly been called in question; and in some recent works on chemistry, its constitution is given as Be.O.

The principle now under consideration appears to draw a plain line of demarcation between oxyds of the magnesia and alumina types. On the one hand, it is a decided property of the neutral salts of the magnesia series, to afford precipitates on the addition of a very small quantity of alkali—such is the case with the protosalts of magnesium, zinc, iron, manganese, cobalt, nickel, and copper—also of cadmium, mercury, and tin. It has been shown, on the other hand, that salts of the alumina class are characterized by their capability of taking up a considerable quantity of their own, or of any stronger base, without the subsidence of any permanent deposit. Most of the protoxyds form only insoluble, pulverulent basic salts. The sesquioxyds enter into numerous, gum-like soluble, subacid combinations.

The examination of the glucina compounds was therefore entered upon with no little interest; because in determining on which side of the line this oxyd falls, there was reason for hoping to throw some new light on a still controverted subject.

With glucina obtained by the method of Berthier, it was found impossible to make a pure nitrate by crystallization. But from a solution of the imperfectly purified earth in sulphuric acid, it is easy to get a pure sulphate in large, compact, dimetric octahedral crystals, that admit of being washed and drained, and are quite permanent in the air. A nitrate free from alumina was procured by decomposing the recrystallized sulphate with nitrate of baryta. It crystallizes with some difficulty, and the crystals are very deliquescent so that they have to be dried over sulphuric acid. The quantity of glucina left after ignition, corresponds to $\ddot{B}e\,\ddot{N}_3\,\dot{H}_9$. This nitrate therefore differs from most others, in containing only three equivalents of water, instead of six, to one of nitric acid. Its point of fusion was found to be about 140° F. Melted and left alone, it began to crystallize when the inserted thermometer stood at 93°. On stirring, the temperature fell two or three degrees, and then rose quickly to 137°.

Ten grams of the crystals subjected to a steam heat for twenty hours, left a thick transparent mass, weighing six grams. This dissolved completely in water, and was found to contain but thirty per cent of dry nitric acid. Its composition, therefore, differed little from $\ddot{B}e_2\,\ddot{N}_3\,\dot{H}_9$. The same salt remains in solution when the normal nitrate is treated with an excess of carbonate of baryta in the cold, only enough baryta being taken up to neutralize half the acid. But by thorough boiling with carbonate of baryta, the glucina is all precipitated as a highly basic salt. This statement of the case may serve to reconcile the contradictory accounts of previous observers, some of whom assert that the earth is not thrown down by carbonate of lime, while others maintain that it is.

The nitrate gives with ammonia in excess, a hydrate in the active state. Indeed, it is not known that hydrate of glucina is ever passive with respect to acids, though that precipitated by boiling a diluted alkaline solution is said to be no longer soluble in alkalies.

By direct combination, the nitrate and the formiate, the chlorid, the bromid, and the iodid can be made nearly but not quite tribasic. By partial neutralization with ammonia, the nitrate may become fully tribasic, and remain perfectly clear.

The sulphate can be got almost tribasic, but the product will not bear large dilution.

Even the fluorid takes up some excess of base.

The acetate dissolves hydrate of glucina till it is rendered almost sexbasic, the solution being a little opalescent. This acetate dries down by spontaneous evaporation to transparent, shining scales. The tribasic salts get thick and sticky in dry air, but are too deliquescent to become hard.

If we suppose glucina to be a protoxyd, the gumlike compounds $\ddot{B}e\,\ddot{N}$, $\ddot{B}e_2\,\bar{A}c$, would have the formulas $\dot{B}e_3\,\ddot{N}$, $\dot{B}e_6\,\bar{A}c$, and would be entirely without parallel among the protosalts. But when there are pleistobasic ferric salts, polybasic chromic salts, hexbasic alumina salts, and tribasic ceric salts, we do not create any startling anomaly in ranking glucina among the sesquioxyds.

The slight solubility of glucina in hot alkalis, its behavior with ammonia salts, and the action of carbonate of baryta on its cold solutions, show that it is less acid and more basic in its character than alumina. Hence where the two earths occur united together, the alumina might be expected to play the part of an acid, and the glucina that of a base. Accordingly while we find in nature minerals of such constitution as $\dot{Z}n\ddot{A}l$, $\dot{M}g\ddot{A}l$, $\dot{F}e\ddot{E}r$, chrysoberyl is found to have a composition which satisfies the formula of the normal sesquisalts, $\ddot{B}e\,\ddot{A}l_3$, just as well as that of the protosalts, $\dot{B}e\,\ddot{A}l$. Chrysoberyl, therefore, whose constitution has been pointed at as reconcilable only with the protoxyd theory, favors one view precisely as much as it does the other.

Berzelius has very justly called attention to the parallelism of the series of simple sulphates of glucina with those of alumina, iron, and chrome, as affording strong confirmation of the older view. And there is, in fact, but one plausible argument in favor of the protoxyd theory, and that is a negative one—the nonproduction of true alums with a glucina basis. Even this will have little force until regular cerium, zirconium, rhodium, and uranium alums can be shown. Besides, it is by no means a universal rule that the double salts of the sesquioxyds consist of one equivalent of a sesquisalt and one of a protosalt. Many of the sesquisalts deserve to be called *polygamous*. We are told that $\ddot{A}l\,\bar{S}_3$ unites

with either $\dot{M}g\ddot{S}$ or $3\dot{M}g\ddot{S}$;—Cr_2Cl_3 with 3KCl;—Fe_2Cl_3 with 2KCl;—Rh_2Cl_3 with KCl, or with $2NH_4Cl$, or with 3NaCl;—Al_2F_3, Zr_2F_3, and Fe_2F_3 with either 2KF or 3KF;—$\ddot{E}r\bar{O}x_3$ with $\dot{K}\bar{O}x$, or $3\dot{K}\bar{O}x$, or $2\dot{N}a\bar{O}x$; and $\ddot{F}e\bar{O}x_3$ with $3\dot{K}\bar{O}x$, or $3NH_4O.\bar{O}x$, or $3\dot{N}a\bar{O}x$. Why may we not then throw the double sulphate of glucina and potash among these variously conjugated double salts, and, in the question of atomic constitution, hold to the more positive guidance of the polybasic compounds?

Thorium.—As the double sulphate of thoria and potash contains one equivalent of sulphate of potash for each equivalent of sulphuric acid combined with the earth, this base was set down, by its discoverer, as a protoxyd. As to the correctness of such a conclusion, there is room for doubt, since none of the protoxyds—that of uranium perhaps excepted—loses its solubility in acids by exposure to a strong heat; while thoria is described as becoming passive by ignition, like most of the sesquioxyds. There is probably, too, an inert hydrate of thoria.

Berzelius says respecting the sulphate, "Si l'on ajoute de l'ammoniaque caustique à une dissolution neutre de sulfate thorique, il se forme un précipité qui ne tarde pas à disparaître, et qui paraît ainsi former un soussel soluble." This creates the suspicion of a polybasic character as belonging to the thoric salts, and it is very desirable that they should be examined with reference to this point. The impossibility of procuring any mineral containing thoria has prevented my following out the inquiry.

Uranium.—The general principle that normal salts contain one equivalent of acid for each equivalent of oxygen in the base, was shown by Graham to be quite at fault in respect to the phosphates; and since then it has been found that there are many polybasic acids. At present we know of but one inorganic subacid base. Those salts of uranic oxyd which are crystallizable and are generally allowed to be normal, contain but one equivalent of acid. Yet this base fully shares the most marked property of the sesquioxyds.

When ammonia is added to the sulphate, $\ddot{U}\ddot{S}$, the precipitate continues to redissolve till half the acid is neutralized. The clear liquid, it is true, at length becomes milky, and finally deposits a whitish sediment, but this is exceedingly small in amount. The chlorhydrate, $\ddot{U}ClH$, acts in the same way. With the nitrate we may go much further before there is any permanent precipitation.

In any solution, all the uranic oxyd cannot be thrown down by an alkali, unless a sufficient excess is added to form an alkaline uranite. And whether the pure hydrates obtained by indirect methods, are in the active state, so as to admit of the production of basic salts by direct combination, I have taken no pains to determine, not supposing that they would be.

But we can make pure soluble basic compounds in the way of precipitation and substitution. The normal sulphate treated cold with carbonate of baryta in excess, parts with two-thirds of its acid; and by decomposing this basic sulphate with a baryta salt, we may get a soluble tribasic nitrate, acetate, or chlorhydrate of uranium. These are of a somewhat deeper color than the normal solutions. The tribasic sulphate may be boiled without change, and after evaporation to dryness it redissolves completely in water.

The singularity of uranic oxyd then, is far from being accounted for by the uranyl theory, as this only gets rid of a strange sesquioxyd, by substituting a more anomalous protoxyd. For here it may be remarked—as in the case of glucina—that $\dot{U}_3\,\ddot{N}$, $\dot{U}_3\,Cl.\,H$, are not unparalleled among sesquisalts, but $3\dot{U}.O.+NO_5$ and $\dot{U}.Cl+2\dot{U}O$ cannot be matched with any known protosalts.

Some have cited the precipitation of metallic silver from the nitrate by protoxyd of uranium, as confirmative of the theory. But if this proves anything, it proves too much, for as protoxyd of iron also precipitates metallic silver, we should have to admit the existence of *ferryl*, and probably, too, of *chromyl* and *stannyl*.

Though there are such compounds as $\bar{S}n.Cl.H.$, and $\ddot{F}e+2Fe_2Cl_3$, and $\ddot{F}e_2+Fe_2Cl_3$, the occurrence of bibasic and tribasic nitrates, shows the impropriety of writing the formulas as $Sn.O.Cl.$, $-Fe_2O.Cl_2-Fe_2O_2Cl$. And why chlorhydric acid does not change sesquioxyd of uranium to sesquichlorid, is not made manifest by giving such a formula as U_2O_2Cl.

However convenient it might be, for some purposes, to have all the bases reduced to protoxyds—by compounding atoms as U_2O_2O, or by dividing atoms as $\dot{F}e\frac{\cdot}{\cdot}O$.—the great difference in chemical relations, between the protoxyds and the higher oxyds, seems to be a grand obstacle in the way.

The uranyl theory fails of completely answering the purpose for which it was framed; and would it not be well to drop uranyl from scientific works, until there is some positive proof of its existence, or till the hypothesis can be of some real service?

It is not many years since phosphoric acid stood alone in its class. And as the field of inorganic chemistry is more fully explored, it may yet be found that there are other subacid bases besides uranic oxyd.

Art. XXIV.—*Zoology of Hayti*; by Dr. D. F. Weinland.*

A few weeks since I returned from nearly half a year's sojourn on the southwestern neck of that beautiful mountain-island, (this is the meaning of the Indian name Hayti,) and I wish to communicate to my scientific friends some of my impressions and observations,† while they are fresh in my mind, even if they should lack the stamp of elaboration.

I shall speak now of the organic life of the sea-shore, and since this depends upon the geological formation of the coast, and upon the nature of the sea, these subjects will first be introduced.

1. *The Sea-shore.*

The northern shore of the southwestern neck of Hayti is mostly *côte de fer*, that is, an iron-bound coast. There are but few small sandy bays, which serve as landing-places for the fishing boats, and near them are generally found huts of fishermen, or a small village.

The rock which bounds all the rest of the coast is a hard brittle limestone, formed very generally of a conglomeration of Madrepores and other corals, as Astrææ, Mæandrinæ, Milleporæ, etc., and of various kinds of shells, cemented with a mass of smaller and formless lime-particles, the powdered particles of the same corals and shells. This rock is full of pores and roundish cavities with sharp edges, perhaps the places where softer shells or fragments of corals have been washed out by the erosion or attrition of the water, or knocked out by corals, thrown up in the stormy winter season of the furious north wind. The species of corals and shells which enter into the composition of this rock, I found nearly all alive in the adjoining sea. Some of them, however, have disappeared from among the living; others are dying out, and are now very rarely found, though common in the earlier portions of the present period; for they exist in great quantities in the rock at the depth of a few feet. Such animal remains enclosed in rock, yet belonging to species now living, or to species now extinct, but which lived in the earlier ages of this period, together with species now living, we are accustomed to call modern fossils. They are the more interesting because they show how, without any remarkable revolution of our globe, certain species of animals gradually die out.

The same rock, composed of modern fossils and their detritus, I found in the interior mountain regions of the island, about

* From the proceedings of the Boston Society of Natural History.

† Most of these observations were made in company with my friend Mr. Edward Habich of Boston, a member of our Society, on our daily walks along the sea-shore, or during our excursions up the rivers or back in the forests of the interior.

thirty miles from the sea-shore, and at a height, as I should judge, of at least one thousand feet above the present level of the sea. Indeed, the first, that is, northernmost, ridge of mountains which runs along that northern sea-shore of Hayti, from east to west, is crowned with large layers or broken masses of this same kind of rock, which being, as stated above, a formation of the present geological period, goes far to show that this whole ridge has been raised in this present period. Thus the existence of the greater part, and the configuration of the whole of the southwestern neck of the island of Hayti is of comparatively recent origin.

Two questions at once suggest themselves here, *Whether the formation of the same rock, and whether the elevation of the land, are going on at the present time.* That the former, the formation of the same limestone rock, is really in progress at the present day, seems to be evident in some places, where the whole bottom of the sea near the shore, at a depth of from one to five and six feet below low-water mark, is, as it were, a flat pavement of the same kind of rock. Crust-building corals, as Porites, Mæandrinas, Siderastræas, etc. live upon it, and in the interstices of these are thrown up from below dead shells, broken Millepores, Madrepores, and Astræans. By the powerful action of the waves on the shallow bottom, these remains are broken and ground upon each other, and their form is lost.

The lime powder which results from this pulverizing action furnishes the cement which fills the shells and unites the pieces into one solid mass, *Maçonnerie bon Dieu* (God's Masonry) as the negroes of the French colonies call it. In consideration of these facts the first part of our question may be answered in the affirmative.

But whether the whole coast is constantly and gradually rising, (as we know is the case with the coast of Sweden,) or whether those different layers of that submarine pavement have been thrown up at various periods, by sudden volcanic agencies, I am at a loss to decide from my own observations. I will only state that the layers which now lie just above low-water mark, are (for instance, in some places in the neighborhood of Jeremie) quite undisturbed banks, running in a plain parallel to the level of the sea. This seems rather to favor the idea of a gradual rising than of a sudden upheaving, for the latter would be more likely to fracture the layers and to change their original horizontal position into an angle towards the horizon.

I conclude, from the information afforded me, that this limestone formation must extend over the whole northern part of Hayti, from its western cape (Tibouron) to the neighborhood of Port-au-Prince. Further, the rocky part of the sea-shore of Barbadoes, Maria Galante, of Grand-terre in Guadaloupe, of Antigua,

St. Bartholomew, St. Martin, Arguilla, and Santa Cruz, seems to be of the same composition and age. I should judge so, also, from an account of William Maclure, published just forty years ago in the Journal of the Academy of Natural Sciences of Philadelphia, vol. i. p. 134, *et seq.* Further also, the honeycomb limestone of Jamaica is the same rock, according to a communication of my friend Dr. Hyde,* who lived in that island for many years.

I have not yet had an opportunity to look for other geological reports of the Antilles. I suppose, however, that this is the same limestone formation, which the negroes in Guadaloupe very appropriately call "God's masonry," and which is so evidently a formation of modern time, since it encloses instruments made by man, and even those once celebrated, supposed fossil human skeletons.

If we want a name for the Haytian limestone described above, we might call it the "modern Coral-rag," for had it not been for the difference in the fossil remains, I should have recognized it as exactly the same limestone, which forms those steep, porous rocks of the so-called rough Alps of Southern Germany, between the Danube and Rhine. Indeed, it was not a slight pleasure for me to see here clearly, how those old rocks of my home must have been formed in their time, millions of years ago, when Southern Germany was yet an island not much larger than Hayti, having a warm climate, and surrounded by a warm ocean; and presenting, all along the coast, the same banks of corals; and in the cavities of these rocks the Cidarites, which abounded then, and of which I found one species alive in Hayti. But this also is so scarce as to show that its days have passed.

2. *The Sea of Northern Hayti.*

Beyond the formation of the coast there are some features connected with the sea, which borders upon the northern side of that island, which are of the greatest importance to its animal and vegetable life.

1. The great respiration of the ocean, the ebbing and flowing of the tide, hardly touches that coast. Neither the native fishermen along the coast, nor the American captains in the harbor speak of high and low water there. The great tide-wave is not only broken by the wall of islands in front of the Mexican Gulf, but, perhaps, is even neutralized by a continual current, which runs from east to west all along the northern shore of Hayti.

* Dr. J. S. Hyde, of New England, a zealous and experienced conchologist by whom were collected many of the Jamaica land-shells, which were described by the late Prof. Adams, tells me that he found this limestone, particularly in the northern part of that island. He noticed it for the great number of Cyclostomas which live in the cavities.

2. All the motion of the sea on that shore depends upon the wind. Its agencies are twofold; first, *the daily change of sea and land wind*, the former beginning to blow in the morning about eight o'clock, the latter in the evening between six and nine. The latter is much more constant, and being also more powerful, it depresses, every evening, the level of the sea all along the coast from one to two feet. But there is, secondly, another, a *yearly change of the winds*, viz.: a prevailing northerly wind in winter, particularly in December, January, and February, and a prevailing southerly wind in summer. This great change produces this effect, that in the season of the North, as they call it there, the level of the sea is constantly, on the average, eight feet higher than in summer.

How much this change bears also upon the organic life of the sea coast, is evident. I will only state that during the last week of May and the first of June, in one place not larger than an acre, more than a hundred Actiniæ and Holothuriæ died, because left upon dry land; not to speak of the thousands of other animals, fishes, echini, etc., and of sea-plants which died in those natural basins near the sea, where the water, cut off from the refreshing ocean, was overheated by the nearly perpendicular rays of the tropical sun. The rising of the land from the waves, the same that we know took place repeatedly in the great epochs of the history of our globe, and which, as has well been said, "brought death among the sea tribes in one universal desolation"—the same we see now on the northern shore of this island, repeated annually with the change of the winds; and though on a smaller scale, yet destroying hosts of living organisms. Moreover, in that stormy sea of the North, the whole bottom of the ocean, all along the shore, at more than five fathoms depth, is swept, and not only all the dead remains but many living shell-fishes, and large blocks of corals, are dashed against the iron-bound coast and thrown up on dry land. This is the season dreaded equally by the Haytian coasters and the merchant vessel in the harbor. The former, when overcome by a dark, stormy night, without a compass, an instrument unknown to them, are driven helpless along the shore, and their small boats frequently thrown against the rocks. The latter, the merchant vessel, drags its anchors on the moving bottom of the sea (called *rade murée*) and runs ashore.*

Besides the motion of the sea, there is one circumstance more worthy of notice, as bearing upon the organic life of this sea-shore. It is the *chemical composition of the sea-water*. The sea-

* In the harbor of Jeremie, which is not protected against this north wind, two vessels ran ashore at one time during one of the last winters. This occurs nearly every year.

water contains, at this distance (about eighteen degrees) from the equator, the greatest amount of salt in solution; more than the water near New England, and a good deal more than the sea immediately under the equator. This remarkable fact has been shown by Linz, a German scientific traveller on his voyage round the world.* The rivers of the northern shore of Hayti are not large enough to exert an extensive influence upon the composition of the sea-water, even in the immediate neighborhood of their mouths, and, moreover, they are generally barred up by sand-banks during a great part of the dry season. These sand-bars prevent again a large pouring in of sea-water into the river, and thus the river water is quite fresh and sweet in the immediate neighborhood of the sea, so much so that vessels take in their drinking water there. But notwithstanding this, (and it is an intereresting physiological fact,) I found relatively more sea-fishes going up annually from the sea into these rivers, than ascend the German rivers; showing how flexible their nature must be to bear the sudden change in the saltness and density of the water, when passing from that deeply saline ocean into fresh water. The case is different with those sea-fishes of New England and Germany which enter rivers; they have always to pass through brackish water, and thus the change is effected gradually.

ART. XXV.—*On the Formation of Continuous Tabular Masses of Stony Lava on Steep Slopes; with Remarks on the Mode of Origin of Mount Etna, and the Theory of "Craters of Elevation;"* by Sir CHARLES LYELL, F.R.S., &c.†—(Abstract.)

THE question whether lava can consolidate on a steep slope, so as to form strata of stony and compact rock, inclined at angles of from 10° to more than 30°, has of late years acquired considerable importance, because geologists of high authority have affirmed that lavas which congeal on a declivity exceeding 5° or 6° are never continuous and solid, but are entirely composed of scoriaceous and fragmentary materials. From the law thus supposed to govern the consolidation of melted matter of volcanic origin, it has been logically inferred that all great volcanic mountains owe their conical form principally to upheaval or to a force acting from below and exerting an upward and outward pressure on beds originally horizontal or nearly horizontal. For in all such mountains there are found to exist some stony layers dipping at 10°, 15°, 25°, or even higher angles; and according to

* See Humboldt's Kosmos, i, p. 320, where we find also the reason for this remarkable fact.

† From the Proceedings of the Royal Society of London for June 10, 1858.

the assumed law, such an inclined position of the beds must have been acquired subsequently to their origin.

After giving a brief sketch of the controversy respecting "Craters of Elevation," the author describes the results of his recent visit (October, 1857) to Mount Etna, in company with Signor Gaetano G. Gemmellaro, and his discovery there of modern lavas, some of known date, which have formed continuous beds of compact stone on slopes of 15°, 36°, 38°, and, in the case of the lava of 1852, more than 40°. The thickness of these tabular layers varies from 1½ foot to 26 feet; and their plains of stratification are parallel to those of the overlying and underlying scoriæ which form part of the same currents. The most striking examples of this phenomenon were met with—1st, at Aci Reale; 2dly, in the ravine called the Cava Grande near Milo, where a section of the lava of 1689 is obtained; 3dly, in the precipice at the head of the Val di Calanna, in the lava of 1852–'53; and 4thly, at a great height above the sea near the base of the Montagnuola.

Sir C. Lyell then alludes to the extraordinary changes which had taken place in the scenery of the Valley of Calanna and the Val del Bove since his former visit to Mount Etna in 1828—changes effected by the eruption of 1852–'53, one of the greatest recorded in history. A brief account is given, extracted from contemporary narratives and illustrated by a map, compiled with the assistance of Dr. Giuseppe Gemmellaro, of the course taken in 1852–'53 by various streams of lava, some of them six miles in length, flowing during nine successive months from the head of the Val del Bove to the suburbs of Zafarana and Milo. The present aspect of this lava-field, parts of it still hot and emitting vapor, and the numerous longitudinal ridges and furrows on its surface are described. As to the origin of these superficial inequalities, the author inquires whether they may be due to the flowing of lava in subterranean tunnels, or whether they be anticlinal and synclinal folds caused by fresh streams pouring over preceding and half-consolidated ones, so that these last may be bent and crumpled by the newly superimposed weight, like soft yielding ground on which a railway embankment has been made. The cascade of the lava of 1852, descending a precipitous declivity 500 feet high, called the Salto della Giumenta, and the stony character of the layers which encrust the steep slope at angles of more than 35° and even 45°, are commented upon. This lava has overflowed that of 1819, which congealed on the same precipice; and it is shown that in such cases the junction-lines separating two successive currents must be obliterated, the bottom scoriæ of the newer dovetailing into the upper scoriæ of the older current.

The structure of the nucleus of Etna, as exhibited in sections in the Val del Bove, is next treated of, and the doctrine of a double axis is deduced from the varying dip of the beds. The strata of trachyte and trachytic agglomerate in the Serra Giannicola seen at the base of the lofty precipice at the head of the Val del Bove are inclined at angles of 20° to 30° N. W., *i. e.*, towards the present central axis of eruption. Other strata to the eastward (as in the hill of Zoccolaro) dip in an opposite direction, or S. E., while, in a great part of the north and south escarpments of the Val del Bove, the beds dip N.E., or N., and S.E., or S., respectively. There is, therefore, a quaquaversal dip away from some point situated in the centre of the area called the Piano di Trifoglietto. Here a permanent axis of eruption may have existed for ages in the earlier history of Etna, for which the name of the axis of Trifoglietto is proposed, while the modern centre of eruption, that now in activity, may be called the axis of Mongibello. The two axes, which are three miles distant the one from the other, are illustrated by an ideal section through the whole of Etna, passing from west to east through the Val del Bove, or from Bronte to Zafarana. Touching the relative age of the two cones, it is suggested that a portion only of that of Mongibello may be newer than the cone of Trifoglietto. The latter, when it became dormant, was entirely overwhelmed and buried under the upper and more modern lavas of the greater cone. This doctrine of two centres, originally hinted at by the late Mario Gemmellaro, had been worked out (unknown to Sir C. Lyell at the time of his visit) by Baron Sartorius von Waltershausen, and has since been supported in the fifth and sixth parts of his great work called "The Atlas of Etna," both by arguments founded on the quaquaversal dip of the beds as above explained, and by the convergence of a certain class of greenstone dikes towards the axis of Trifoglietto. Von Waltershausen has also shown, that the superior lavas and volcanic formations crowning the precipices at the head of the Val del Bove, from the Serra Giannicola to the Rocca del Corvo inclusive, are unconformable to the highly inclined beds in the lower half of the same precipice, the superior beds being horizontal, or, when inclined, dipping in such directions as would imply that they slope away from the higher parts of Mongibello.

According to Sir C. Lyell, the alleged discontinuity between the older and modern products of Etna is, in truth, only partial, and almost confined to that flank of the mountain, where its physical geography has been altered by three causes: 1st, the interference of the two foci of eruption (Trifoglietto and Mongibello); 2ndly, the truncation of the cone of Mongibello; and 3rdly, the formation of the Val del Bove. The truncation of the mountain here alluded to is proved by the remains of the upper

portion of a cone, traceable at intervals around the borders of an elevated platform between 9,000 and 10,000 feet high. These remains bear the same relation to the highest and active cone, nearly in the centre of the platform, which Somma bears to Vesuvius. The manner in which the north and south escarpments of the Val del Bove diminish in altitude as they trend eastward from the high platform, is appealed to as showing that the great lateral valley had no existence till after the time when Mongibello had attained its fullest development and height.

The double axis of Etna is then compared to the twofold axis of the island of Madeira, as inferred from observations made in 1854 by M. Hartung and the author. In that island the principal chain of volcanic vents, running east and west, and thirty miles long, attains at one point a height of 6000 feet. Parallel to it, at the distance of two miles, a shorter and lower secondary chain once existed, but was afterwards overflowed and buried to a great depth by lavas issuing from the higher and dominant chain. The space between the two axes, like the space which separated the two cones of Etna, has been filled up with lavas in part horizontal. On the north side of Madeira, as probably on the west side of Etna, where no secondary centre of eruption interfered with the slope of the volcanic formations, and where the order of their succession and superposition is uninterrupted, there occur, both in Madeira and Etna, deep crateriform valleys (the Curral and the Val del Bove) intersecting the products of the two axes of eruption.

In concluding this part of his memoir, Sir C. Lyell observes, that the admission of a double axis, as explained by him, is irreconcileable with the hypothesis of "craters of elevation;" for it implies that, in the cone-making process, the force of upheaval merely plays a subordinate part. One cone of eruption, he says, may envelop and bury an adjoining cone of eruption; but it is obviously impossible that one cone of upheaval should mantle round and overwhelm another cone of upheaval.

An attempt is then made to estimate the proportional amount of inclination which may be due to upheaval in those parts of the central nucleus of Etna where the dip is too great to be ascribed exclusively to the original steepness of the flanks of the cone. The highest dip seen by the author was in the rock of Musarra, where some of the strata, consisting of scoriæ with a few intercalated lavas, are inclined at 47°. Some masses of agglomerate and beds of lava in the Serra del Solfizio were also seen inclined at angles exceeding 40°. Some of these instances are believed to be exceptionable and due to local disturbances; others may have an intimate connection with the abundance of fissures, often of great width, filled with lava, for such *dikes* are much more frequent near the original centres of eruption than at

points remote from them. The injection of so much liquid matter into countless rents may imply the gradual tumefaction and distention of the volcanic mass, and may have been attended by the tilting of the beds, causing them to slope away at steeper angles than before, from the axis of eruption. But instead of ascribing to this mechanical force, as many have done, nearly all, or about four-fifths of the whole dip, Sir C. Lyell considers that about one-fifth may, with more probability, be assigned as the effect of such movements.

The alleged parallelism and uniformity of thickness in the volcanic beds of the Val del Bove, when traced over wide areas, is next considered, and the author remarks that neither in the northern nor southern escarpments of the great valley, could he and his companion verify the existence of such parallelism. Examples of a marked deviation from it are given, both in cliffs seen from a distance, and in others which were closely inspected, even in cases where these last, when viewed from far off, appeared to contain regular and parallel strata.

The direction and position of the dikes in the Val del Bove is then spoken of, both in reference to the two ancient centres of eruption, and to the question of the altered inclination of the intersected beds. In regard to the arrangement also of the lateral cones of eruption, the question is entertained, whether they are disposed in linear zones, or are in some degree independent of the great centre of Mongibello.

The origin of the Val del Bove has been variously ascribed to engulfment, explosion, and aqueous erosion. Admitting the probable influence of the first two causes, the author calls attention to the positive evidence in favor of aqueous denudation afforded by the accumulation of alluvium in the lower country at the eastern base of Etna between the Val del Bove and the sea. This rudely stratified deposit, 150 feet thick and several miles in length and breadth, contains at Giarre, Mangano, Riposto and other places, fragments, both rounded and angular, of all the rocks, ancient and modern, occurring in the escarpments of the Val del Bove, and it implies the continuance there for ages of powerful aqueous erosion. The alluvium of Giarre is therefore supposed to bear the same relation to the Val del Bove that the conglomerate of the Barranco de las Angustias bears to the Caldera of Palma in the Canaries; and those two crater-like valleys, as well as the Curral of Madeira, are believed to have been shaped out in great part by running water. But to render this possible, the suspension, for a long period, of the outpouring of lava on the eastern flank of Etna must be assumed.

The author fully coincides in the generally received opinion that the accessible parts of Etna are of subaërial origin, and refers to some fossil leaves presented to him by MM. Gravina and

Tournabene, of Catania, as well as to others collected by himself *in situ*, from the volcanic tuffs of Fasano and Licatia, which have been determined by Prof. Heer to belong to terrestrial plants, of the genera Mytle, Laurel, and Pistachio, now living in Sicily. These tuffs, together with the general mass of Etna, repose on marine strata of the newer Pliocene period, in which 150 species of shells, nearly nine-tenths of them identical with species now existing in the Mediterranean, have been found. A very modern marine breccia, with shells of living species extending to the height of thirty feet on the coast along the eastern base of Etna, was pointed out to the author by Signor G. G. Gemmellaro near Trezza, and in the island of the Cyclops. The same formation has been traced together with lithodomous perforations by Dr. Carlo Gemmellaro and Baron v. Waltershausen along the seashore as far north as Taormina, beyond the volcanic region of Etna. From these and other data, enlarged upon in the memoir, Sir C. Lyell concludes, first, that a very high antiquity must be assigned to the successive eruptions of Etna, each phase of its volcanic energy, as well as the excavations of the Val del Bove, having occupied a lapse of ages compared to which the historical period is brief and insignificant; and secondly, that the growth of the whole mountain must nevertheless be referred geologically, to the more modern part of the latest Tertiary epoch.

Art. XXVI.—*Geographical Notices.*—No. III.

The Telegraph Plateau.—Remarkable Discrepancies in the Published Statement of Soundings.—In a recent letter to Dr. Petermann, published in his *Mittheilungen* (Dec. 1857, p. 507), Lieut. Maury presents a statement in respect to the so-called "Telegraph Plateau," and the soundings upon it by Lieut. Berryman, U. S. N., from which we propose to make some extracts.

As the subject is of general interest, we give a brief account of the Atlantic soundings referred to, before quoting Lieut. Maury's remarks.

In July, 1856, Lieut. Berryman, U. S. N., acting under the authority of the Secretary of the Navy, left New York in the government propeller "Arctic" for the purpose of making soundings between Newfoundland and Ireland, and "ascertaining if possible the practicability of laying a telegraphic wire or cable between America and Europe." From the official report it appears that he left St. John's July 31, and reached Queenstown Aug. 22, after having effected, at intervals of different extent, numerous soundings, "all attended with complete success." Returning he left Queenstown Sept. 10, and arrived at St. John's

Sept. 30, having sounded on this trip "only in the intervals unavoidably neglected in going out.'

Upon his return no doubts were entertained of the feasibility of laying the cable. In fact Lieut. Berryman remarks, "nothing seems easier, now that the character of the bottom is known and the depth ascertained to a nicety which was hardly ever expected." "The incalculable usefulness" of these soundings is referred to in the annual report of the Secretary of the Navy with avowed pride, and the enterprize and accuracy of Lieut. Berryman are commended in corresponding terms.

On the report of these soundings the projectors of the transatlantic telegraph appear to have relied in deciding upon the course in which an attempt should be made to lay their cable. Their official statement contains a sketch of the plateau derived from the soundings of Lieut. Berryman. "This submarine ledge," says the report of the company, "has been very accurately examined by soundings, and it is found that it is nowhere deeper than 12,000 feet (a trifle more than two miles). It dips down slightly from either coast, reaching its greatest depression in mid ocean; but the slope is a very gradual and easy one, and the surface is devoid of all abrupt irregularities."

The appended sketch, said to be derived from Berryman's survey, is not only free from undulations remote from the coast, but represents an easy gradual inclination from both shores outward. The measurements thus accepted and endorsed have induced far and wide the belief that between Cape Race and Cape Clear, there is a smooth surface, of moderate depth, "designed by Providence" to connect by electrical sympathies the Old World and the New. Hence the name "Telegraph Plateau."

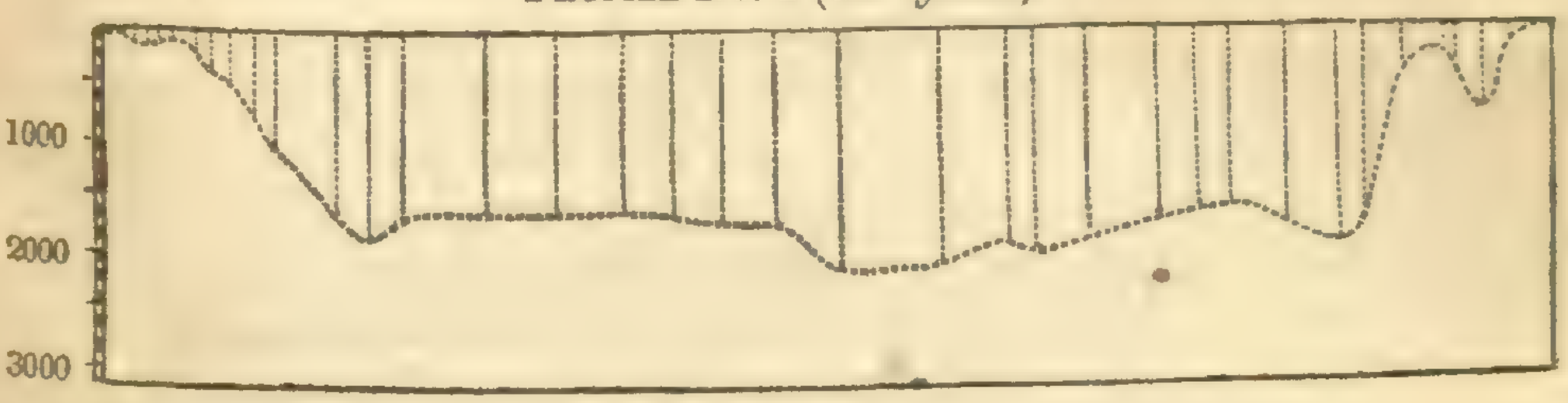
But all the apparent certainty which is said to have mapped the surface of this plateau "with considerably greater accuracy than the interior of the continents of Africa and Australia," has been set aside by recent revelations. Lieut. Maury's letter, above referred to, which acknowledges this unexpected disclosure, is accompanied in the *Mittheilungen* by three sketches of sections of the plateau, derived from identically the same soundings but marvelously unlike, as will be seen in the copy of them which is herewith presented.

For the explanation of these diagrams it is necessary to remark that the line of soundings extended from the coast of Newfoundland to Ireland. Each sounding is marked by a perpendicular line. The reported bottom of the plateau is indicated by the dotted line running from east to west. In the third diagram the different soundings obtained in going out and in coming back near the Newfoundland coast are indicated. The perpendicular lines are exaggerated one hundred times in proportion to the horizontal.

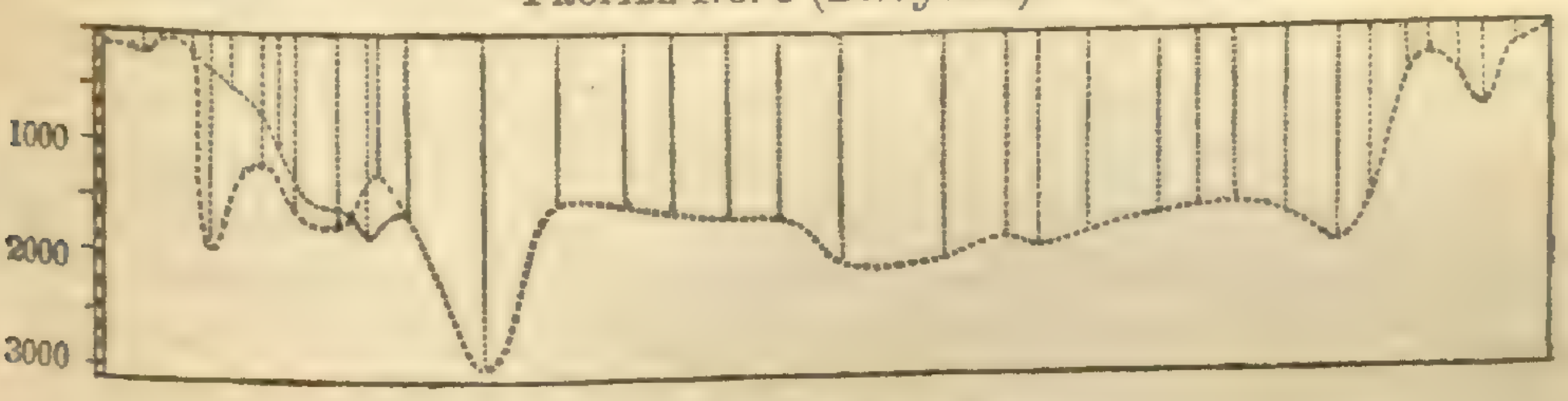
In respect to these sketches Lieut. Maury writes as follows: "Lieut. Berryman sent over from Ireland to the Navy department a vertical section or side view of the depth of water upon this plateau (profile No. 1).

PROFILE No. 1 (*Berryman*).

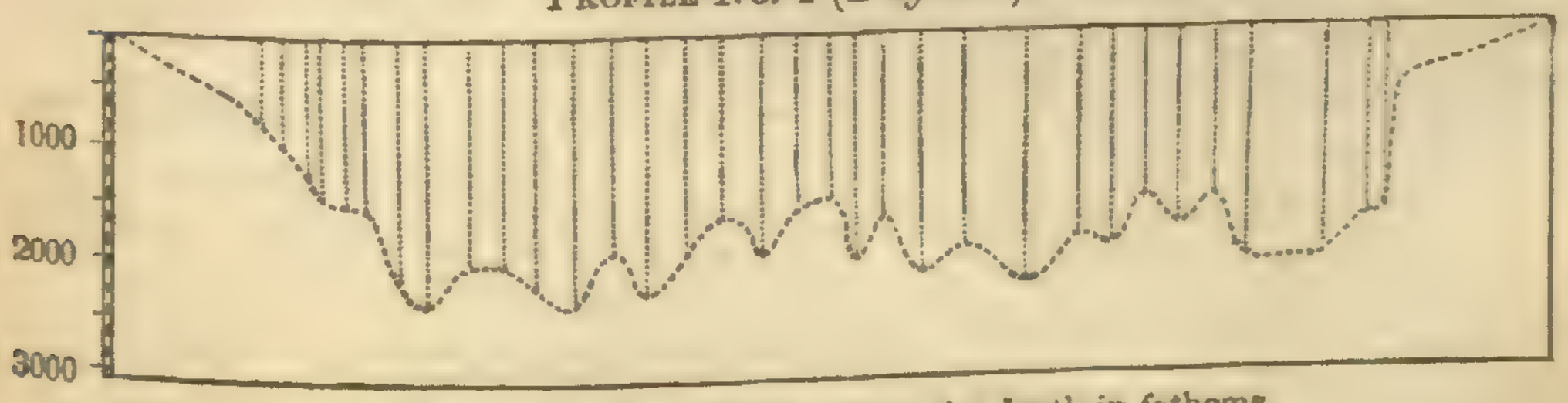
PROFILE No. 2 (*Berryman*).



PROFILE No. 3 (*Berryman*).



PROFILE No. 4 (*Dayman*).



The numbers 1000, 2000, 3000, indicate the depth in fathoms.

"Upon his return to the United States certain differences were pointed out between the depths which the profile indicated and the original soundings as they are stated in the abstract log of the ship. Hereupon he presented a second profile as the correct one (profile No. 2). But upon its examination it was found that neither of the two agreed with the depths which are stated in the abstract log from day to day as the soundings were accomplished (profile No. 3).

"The method employed in the deep soundings was evidently faulty. He had employed "Massey's Indicators" without hav-

ing corrected their errors and without having taken precautions to determine the rapidity of the running out of definite lengths of line, by which errors could have been avoided. Moreover differences appeared every time that two soundings were made nearly on the same place, one in going out and the other in coming back, as was several times the case. For example, between the last sounding, 120 fathoms upon the bank of Newfoundland, and the meridian 43° W., he sounded seven times on the way to Ireland and six times on the way back. The different depths thus obtained are indicated by a second dotted line upon the third profile. The whole work proved, therefore, worthless, and must be done over."

Soundings were made by Lieut. Dayman, R. N., in the British ship "Cyclops," in the summer of 1857, before the unsuccessful attempt to lay the cable. A section illustrating the results which he obtained is published in connection with the three sections of Berryman (profile No. 4). "It shows," says Lieut. Maury, "remarkable undulations of the bottom between Ireland and Newfoundland which continue about half the entire distance. Here the deep and shallow places alternate with such striking regularity that the question suggests itself whether this wave-shaped bottom is not to be ascribed rather to an accidental error or to the different manipulations of those who were charged with the soundings than to the real physical configuration."

It is not surprising that the statements of this letter should call forth both criticism and satire. The discrepancies in the reported profiles of Lieut. Berryman, and their great dissimilarity to the profile of Lieut. Dayman occasions the following remarks in the *Zeitschrift fiir allgemeine Erdkunde*, 1857, p. 77. After quoting a part of the above letter of Lieut. Maury, the article continues:—"In the third reading [of Berryman] occurs the enormous depth of 3000 fathoms which makes such a hazardous breach in the idea of the 'telegraph plateau,' and that too in the very place where the sea, according to the first profile, ought to be only 1400 fathoms deep.

"But however much these three sketches differ from one another, they bear to the profile made from Lieut. Dayman's soundings and particularly to the idea of a 'plateau' no greater resemblance than a ploughed field to a parquet floor. Dayman's profile shows such a stubborn (*hartniickige*) series of heights and depths that the very idea of a plateau is put to ridicule. It represents, we are sorry to say, exactly in the place where, according to the third distillation of Lieut. Berryman's sketches, the greatest depth of 3000 fathoms should be, a fine mountain, which elevates itself more than 2000 feet above the adjacent valleys to the east and west.

"Lieut. Maury naturally ponders with shakings of the head 'the remarkable undulations' of the bottom which this profile indicates."

Quoting then his hypothesis as given above, the article goes on: "But since the different peaks given upon the sketch are neither of approximatively the same height and are not equally distant from one another, we are not in a position to recognize in the alternation of heights and depths a 'remarkable regularity.' The profile presents indeed only an alternation of heights and depths, but if the idea of a plateau is abandoned this is less remarkable than natural."

The article of Prof. Trowbridge, of the United States Coast Survey, printed in this number of the Journal, (p. 157,) discusses in a thorough manner the elements of error in the soundings of Berryman and Dayman. Its concluding remarks demand repetition in this connection.

"With all its imperfections, however, Massey's indicator furnishes better results when carefully used, than the method of measuring the depth by the line out; and for this reason I think the soundings of Lieut. Berryman where he used the indicator, on the line of the Atlantic telegraph, are much nearer the truth than those of Lieut. Dayman.

"In both cases the probable errors are very large, amounting in many instances, I think, to several hundred fathoms.

"The idea of a 'Plateau' existing between Newfoundland and Ireland is not warranted it seems to me by any observations that have yet been made. The range of errors may be as great as 500 fathoms, which would admit of the existence of a submarine mountain on this line, half as high as Mount Washington. A true section of the Atlantic can only be determined by improved modes of sounding. Since from the preceding discussion we may be warranted in the conclusion that it is practically impossible to determine the greatest depths of the ocean by the methods now in use."*

New Explorations in Central Africa.—The European Journals announce another expedition into Central Africa. Its projector is Baron von Krafft, whose intention is to visit the interior of Soudan. He has embarked for Tripoli, and will probably take the route from Ouargla to Djebel Hoggar, a route which has never been followed by Europeans.

A letter from Baron Krafft to Humboldt, dated April 10, 1858, from Algiers, expresses the desire of the author to continue the

* The following errata in the paper of Prof. Trowbridge were received after it had gone to press.—Eds.

Page 158, 1st line from top, for "95" read "96."—Page 169, in the formula and in the second line below it, for "v" read "V."—Page 170, 3d line from bottom, after "as much as" insert "one-fourth of."

discoveries of Dr. Barth, so far as limited resources will allow. He will travel in the incognito of a Turkish physician, provided with allopathic and homœopathic medicines, and attended by an Algerian Moor, who is acquainted with the native method of practice. An aneroid barometer, several thermometers, two compasses, a chronometer, a sextant, and a telescope, are the instruments which he carries. He intends, however, to devote himself chiefly to such observations as can be made without his instruments, to collect minerals and plants, to inquire into the trade, language, history and literature of the people whom he visits, and to determine with the greatest possible accuracy the various routes of caravans and their chief stopping places.

The route of travel which Baron Krafft has marked out for himself is from Tripoli to Ghadames, and thence to Aïn Salah and Timbucktoo. Then he proposes to visit Lake Tsad, and afterwards to go according to his strength and means, either east to Wara and Dar Fur, or north to Bilma, Seggadem and Murzuk.

Möllhausen's Journey West of the Mississippi.—Möllhausen's *Tagebuch einer Reise vom Mississippi nach den Kusten der Sud-see,* (Diary of a Journey from the Mississippi to the Coast of the Pacific,) referred to in the May number of this Journal, has been published in Leipsic, in a quarto volume of about five hundred pages, illustrated by thirteen prints in oil colors, ten wood cuts, and one map. The mechanical execution of the work is of the highest order. The author, it will be remembered, was employed in the Pacific Railroad Surveys, as draughtsman to the expedition commanded by Lieutenant Whipple, whose report illustrated by some of Möllhausen's sketches forms the second volume of the series.

The volume now before us is an important contribution to our knowledge of the ethnography of the regions which were visited. It is introduced to the public by a preface from Alexander Von Humboldt.

The author, in his concluding page, expresses his intention to accept an invitation to join the Colorado expedition, now in the field under the command of Lieutenant Ives.

Rawlinson's Herodotus.—The first and second volumes of a new translation of Herodotus have just appeared in England. The work is entitled: *The History of Herodotus, a new English Version, edited with copious Notes and Appendices, illustrating the History and Geography of Herodotus, from the most recent sources of information; and embodying the chief results, Historical and Ethnographical, which have been obtained in the Progress of Cuneiform and Hieroglyphical Discovery;* by George Rawlinson, M.A., assisted by Col. Sir Henry Rawlinson, K.C.B., and Sir J. G. Wilkinson, F.R.S. Vols. 1 and 2; with maps and illustrations.

Its value consists not mainly in the new English version, but in the copious notes which illustrate every page, the introductory chapters by the editors and the extended essays which conclude the volumes.

Two of these essays appended to the first volume present a clear and concise review of what is known in respect to the physical geography of western Asia. The second essay is devoted to Asia Minor, and the ninth, which extends through over fifty pages, is devoted to Mesopotamia and the neighboring countries. The eleventh essay discusses the ethnological affinities of western Asia. Besides these essays of a geographical character, there are others on historical and religious topics likewise full and elaborate. Vol. 2 is chiefly upon Egyptian history. One of its essays is on the Topography of Babylon.

D. C. G.

ART. XXVII.—*On Chinese Poisons;* by D. J. MACGOWAN, M.D.

IN consequence of the atrocious attempt of the Cantonese to poison the foreign community at Hongkong, applications have been made to us from various quarters for information on poisons known to the Chinese. An investigation of Chinese toxicology would require much time, and special study, which we despair of being able to devote to that interesting subject. In default of presenting anything of value to the scientific inquirer, we submit for the perusal of the general reader the limited information we possess on Chinese poisons. From the period of the Han dynasty to the present day poisoned arrows have been employed, both in the chase and in warfare; less, however, by the Chinese proper than by the so-called aborigines or Miautsz. In the hands of the latter, they are formidable weapons. Instant death is inevitable from the slightest abrasion. The Chinese possess no agents for counteracting the poisons of the hill tribes; the *Pun Tsau* states that these Inner Barbarians apply borax sometimes with success to poisoned wounds; and it is commonly reported that for their various virulent poisons they possess perfect antidotes.

We are acquainted with only one of the *inoculating* poisons of the Chinese—a watery extract of the root of *tsau-wu*—a perennial creeper found on the hills of the central provinces. Its botanical character, as well as its precise physiological action, we have yet to ascertain. Its active principle appears to be highly volatilizable, and great exactness is needed in preparing it. Small animals are kept in readiness for testing the strength of the extract; they are punctured with a point charged with the poison, and when its virulence is sufficient to occasion instant death, it is

boiled no longer. A native physician who saw it prepared by the hunters of the adjacent district of Funghwa, states that sometimes they prick their arms to let blood flow to the wrist, and after carefully wiping the part near the wound, apply some of the pasty extract to the lower end of the line of blood, which it rapidly blackens through its whole length; and it is affirmed, that were the continuity with the incision unbroken the morbific action of the subtile agent would penetrate the wound and prove quickly fatal. It is sometimes applied to the tongues of the unwary as a practical joke—when it occasions a keen sensation of formication. The dried root is administered where the nerves of motion are impaired. The Funghwa hunters traverse in winter the mountainous regions of Chihkiang in pursuit of tigers that are sometimes taken by being pierced with arrows, the necks of which are bound with filaments of cotton saturated with the poison; at other times, springs charged with these arrows are adjusted near the lair of the animal for his destruction. When a limb is struck the beast writhes awhile before expiring, but when wounded in the body, he leaps forward, staggers and falls dead immediately.

Attached to the imperial body guard is a corps of hunters, who, when on the chase in pursuit of edible game, provide themselves with envenomed missiles to be employed against wolves.

Latterly, poisoned arrows have fallen into comparative disuse as implements of war, owing to an increasing familiarity with fire-arms. We are acquainted with the contriver of a machine which was designed to be used against the English during the late war. It succeeded so well in picking off goats which were led over the cords communicating with it, that the military commission strongly recommended its adoption for destroying barbarian bipeds. Unfortunately for the patriotic inventor, the Treaty of Nanking caused the dispersion of the game just as it was ready, as he supposed, to be largely secured. It need hardly be added that in the hands of assassins, this easily obtainable poison would prove a potent means of destruction, as a slight puncture of an instrument charged with it, would from its rapid absorption be a sure *coup de grace*.

It is not our purpose to point out all the virulent agents which unscrupulous Chinamen are likely to employ against an enemy. We shall only add one more of the inoculating class, and that chiefly on account of its novelty. When the late commissioner Lin was devising means for the extirpation of English barbarians at Canton, some of the gentry of that city actually proposed to His Excellency to rid the place of certain prominent and obnoxious individuals by infecting them with *leprosy*.

Lin indignantly rejected the proposition as unbecoming a civilized people. That Chinese statesman was a brave and honorable man; his present Manchu successor has no claim to such virtues.

His chief objection to the use of leprous virus was, it is said, the tardiness of its action; it is believed that more than a month elapses after the introduction of the animal poison before it begins to show itself in its victim. Our knowledge of this foul malady is too imperfect to justify us in pronouncing such an inoculation as impracticable. Nor have we any remedy to propose for an officer who finds himself thus tainted.

There are poisons also which are *inhaled*. A person who aided a magistrate in the administration of a poison of this class gives the following narrative of the transaction, which was a *filiicide*. (Our apology for coining this word is, that it is needed to denote a crime, or rather extra-judicial practice not uncommon in China, resorted to for making away with dangerous adult sons.) The son of that officer was a lawless and incorrigible character, who by misdemeanors periled the safety of his family, and they determined on his removal. To effect that object without publicity no small finesse was requisite on the part of his father and friends. Suspecting their designs, he became excessively wary. On the day agreed for his execution, the father feigned to be withholding the son's much loved opium, until he could induce the hapless youth to take a draught of tea, which he was artfully led to suppose was drugged. At length, affecting to be wearied by the son's contumacy, the father gave him his opium pipe, mixing with the genial papaver another drug intensely poisonous. After a few inhalations the victim fell into a stupor, which was followed by convulsions to which his athletic frame succumbed in less than six hours.

To the same class belong those drugs which are employed by burglars for stupefying the inmates of the house to be robbed. Ever since we read in commissioner Lin's anti-opium diatribe, references to medicines used by robbers, kidnappers and sorcerers, which that statesman compared to the prohibited narcotic, we have been vainly endeavoring to investigate their nature. There is, however, abundant evidence that such agents are employed to induce stupor for criminal purposes.

Kidnapping male children for sale in Siam or the Straits has long been a common practice on the seaboard, and a short time since, to meet the demand for Chinese females in Cuba, many girls were kidnapped. The provincial capital—Hangchau, was thrown into consternation in consequence of the paucity of slave labor in the West Indies. Popular placards and official proclamations were posted everywhere, warning the inhabitants against the villainous agents of foreign barbarians who were prowling in search of female children. Two miscreants were detected with their little prizes and immediately beaten to death. From the documents published on that occasion it appears that for very young children a drug is employed which on being applied

to the face produces a degree of insensibility enabling the operator to lead the little one away unresistingly. For those of a larger growth, as well as for adults, something is given which by irritating the throat causes aphony. At other times they seem to employ an anæsthetic for criminal purposes.

We must adduce one instance of a proposal to stupefy by drugs of this character. When Ningpo was in possession of the English, a bold effort was made for its recapture by surprise. A large number of "braves" were secretly housed in the city, and a few hours before the time appointed for rising, the mandarin sent for distribution among a portion of the concealed force, a quantity of stupefying drug in the form of pastiles. Arrangements were made for a simultaneous attack on the west and south gates by night, and while some of those within the city were to set off noxious vapor in houses occupied by the English, others were to force open the gates. The plot failed through the dilatoriness of the fumigating squad. They arrived too late. The noise of the attack aroused the English, and its partial success, enabling a large force to enter the city, caused a dreadful carnage among the spirited assailants. Yet their confidence in the utility of fumigation was not impared, for it was not long after that a barbarian soldier was captured by this means and beheaded. Many were the plans set afoot for the capture of the English chief *Pu-ting ché*—for whose head ten thousand taels were offered.

It is said that for nearly every poison its antidote may be found. These soporific pastiles come within the number. The difficulty in poisoning cases is to know where to look for the desired neutralizer. That our toxicological notes may not be wholly devoid of practical information, we shall give some simple directions for the guidance of those whose premises are invaded by fumigators. It is assumed that you are wide awake at the time, for if you are caught napping there is no remedy. In the first place, then, take care that you do not open your mouth; but holding your breath, rush at the intruder and seize his cue in your left hand, while with the thumb and index finger of the right, you lay hold of his nose just above the alæ with a firm gripe; a bolus will drop out of each nostril, with which you are to plug your own nasal passage (be not fastidious) and you may then commence breathing (your mouth still closed)—for these medicated pledgets possess the property of decomposing the somnolent gas. If successful in these manipulations you will have the gratification of seeing your foe gasp and tumble over *hors de combat* into the pit he had prepared for you.

Allusions are often made to a mysterious and extremely virulent poison taken by men of high rank when on the eve of execution; it is derived, according to vulgar belief, from a protuber-

ance on the head of a species of stork. Whatever the agent may be, it is unquestionably one of great potency. An officer who was eye-witness to the decapitation of the venerable and lamented general, Yu Tsien, informs us that when that victim of Manchu malignity was lead out to slaughter, something was placed on the tip of his tongue, which, without the infliction of pain, rendered him insensible in less than half an hour. Friendly mandarins then retained his moribund frame in an erect posture to receive the painless death blow.

Nearly all the vegetable and mineral poisons known in the West are found in China, and have been employed for homicidal or suicidal purposes. Laurel water, hemlock, hyoscyamus, belladonna, stramonium, and nux vomica and a long list of other indigenous plants, known and unknown, are always at hand, though not often employed, owing to the facility of obtaining opium. Dogs are often poisoned by thieves by giving them rice in which nux vomica has been boiled. It is not an uncommon practice for countrymen to throw an infusion of *Croton tiglium* into a pond, a mode of fishing make easy—the morning following the operation every fish is found floating on the surface dead. They are then taken to market, but though somewhat insipid are innocuous. Some species of fish common on the coast are reputed to be intensely poisonous. Several kinds of mushrooms are also poisonous, and these, with other edible poisons are employed by those who aim at robbery or murder. For suicide, the most common agent, after opium, is the sediment of brine—which is highly corrosive. Pure gold is not uncommonly used; it probably acts in the same manner. Quicksilver has also been used for the same purpose; we are uninformed respecting its action. Arsenic, although cheap and abundant, is not easily procured, venders being held responsible for consequences, whether suicide or murder. The yellow sesquisulphuret (*orpiment*) abounds in Kungchàng in the S.W. of Kansuh. It is applied externally to poisoned wounds; as a sternutatory to counteract miasmatic effluvia in summer, and internally as a tonic in several diseases, and as a prophylactic; on the fifth day of each fifth month, persons of every age and condition drink spirituous liquor in which some powdered orpiment has been thrown, under the belief that it is a preventive of epidemic diseases. The Chinese do not consider this mineral as related in any way to arsenic. By arsenic they mean the red or protosulphuret, (*realgar*). This mineral is found abundantly in Sinyang-Honan. Arsenious acid (*white oxyd*) is also met with as a collateral product, it is said, in some glass works, derived doubtless from an ore of cobalt. The sulphurets were known to the ancient alchymists of China, and were early

employed in medicine; the utility of the last named in intermittent fever has not been long known, says the Pun Tsau (Materia Medica). Water in which common green beans has been boiled and pounded is given in cases of arsenic poisoning. It can be of use only as a demulcent. We are told that Mongolian hunters beyond the wall eat it to enable them to endure cold when patiently lying on the snow to entrap martens. In this part of China, arsenic is taken by divers, who in cold weather plunge into still water in pursuit of fish which are then found hybernating among stones at the piers of bridges.

We perceive with regret that the modern Chinese have added arsenic to their habitual stimulants. The red sulphuret in powder is mixed with tobacco, and their joint fumes are smoked in the ordinary manner. We have met with no habitual smokers of this compound of mineral and vegetable poisons, but persons who have made trial state that dizziness and sickness attend first attempts. After a few trials arseniated tobacco may be taken without any apparent inconvenience. From reports given of it we infer that its effects on the Chinese are analogous to what is observed among the arsenic-eating peasants of Austria. The use of arsenical vapor by inhalation merits the attention of physicians as a remedial agent.

At Peking, where arseniated tobacco is most in use, it costs no more than the unmixed article; it may be known by the red color imparted to the vegetable by the powdered protosulphuret. Its introduction is attributed to Cantonese from Chauchau. If this be correct, it is probable that these southerners, unable at the north to procure the masticatory to which they were addicted, sought to appease a craving for the pungent but harmless lime and betel-nut, by substituting the deleterious mineral gas. Many of the miserable victims of opium, to whom that narcotic is a necessity and not a pleasure, have eagerly employed the new stimulant to prop and exhilarate their exhausted bodies, and perhaps have thereby meliorated and prolonged their existence. We would fain hope that the use of arsenical stimulants will not become general; yet that pernicious custom is extending, and we know our race too well not to entertain fears on the subject. It is even stated that for a time at least, the reigning emperor in his boyhood preferred tobacco thus mineralized. Arsenical ores are used in the arts. In domestic economy the red sulphuret is employed for making away with rats and husbands.

There is no evidence that poisoning as an art has been practiced in China, and we search her annals in vain for a case parallel to that of Hongkong. Novelists sometimes describe the poisoning of armies or large numbers of people. The account of the aboriginal chief Manghwoh, who poisoned the springs of which the Chinese army drank, will recur to the reader of the historical

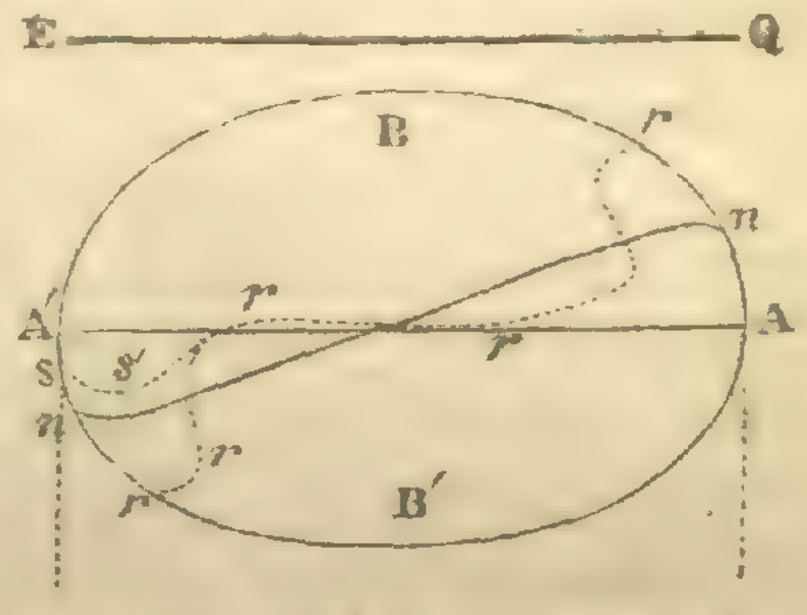
romance—the Three States. It may be that instances of this kind are founded on fact; but the obvious futility of any attempt to poison fatally on a large scale is a guarantee that it will be seldom resorted to in warfare. Could such appliances be made subservient to the destruction of masses of men, they would certainly be put in requisition, as total annihilation of antagonists is the aim of Chinese heroes: "no quarter" is their war cry.

Ningpo, March 2, 1857.

Art. XXVIII.—*Note on the Currents of the Oceans;* by James D. Dana.

[Communicated to the American Association at Baltimore.]

In the annexed figure, if $A\,A'$ represent a large elliptical basin of water warmed on the side towards $E\,Q$ and kept cold on the opposite, the isothermal diameter (or line of mean heat in the water's surface) will have the direction $A\,A'$. But if the water were put in equable circulation about the centre, in the direction of $A\,B\,A'\,B'$, the isothermal diameter, instead of having the direction $A\,A'$ would run obliquely across, like $n\,n'$, since the warm waters would be flowing in the direction $B\,A'$, and the cold in that of $B'\,A$. Or conversely, if in such a basin, warm on one side and cool on the other, as stated, an isothermal line had this oblique position it would be evidence of an elliptical movement in the waters.



Again if the waters moved most rapidly towards the margin of the basin, then the isothermal line might take the form $A\,r\,r\,r\,r\,A'$. This form would also result from the gradual shallowing of the basin towards its sides, since a slight motion about the deeper parts would be magnified in the shallower waters of the border, (friction here being set aside, as it would have little effect if the basin were hundreds or thousands of miles in extent and of corresponding depth). Moreover, if either current, the warmer or colder, were an under current, the sloping sides of the basin would bear it up to the surface, and cause it there to affect the surface temperature, while elsewhere it might be unperceived. If in addition, the effect of the *colder* side were augmented, then a given isothermal line as $A\,r\,r\,r\,r\,A'$ might have a deeper bend on the side struck by the cold current than on the opposite, and so have the form $A\,r\,r\,r\,s'\,s\,A'$.

This figure and these conditions have a parallel in the oceans. The oceanic basins have their warm side against the equator, and

their cold towards the polar regions. In the isothermal (or isocrymal) chart in my Expl. Exp. Report on Crustacea, and also in this Journal, vol. xvi, p. 153, I have given the direction of the isothermal lines of the surface water of the ocean in winter—or rather, in the coldest month of the year, each line corresponding to the mean temperature of the coldest month. In this chart, the isothermal lines closely correspond with the above diagram.

The mean position of the line of 68° is about half way between the equator and the parallel of 55°, within which the circuit mainly lies; and we may, therefore, take this line for our illustrations. We may look first to the South and North Atlantic. In the *South Atlantic*, this line reaches obliquely across, from latitude 31° S. on the South American coast (the western side of the ocean, longitude 47° W.) to 7° S. on the African side (the eastern, in longitude 12° E.); and the line is almost straight, excepting the flexures near the coast, while the mean course makes an angle with the parallels or equator of about 22°. In the *North Atlantic*, the same line 68° F., is similarly oblique. It reaches from 56° N. on the American side, to 14° N. on the African, and the angle its mean direction makes with the equator is about 20°. Thus in each of these cases, the demonstration of the fact of an elliptical circuit movement in the ocean, is apparently complete. The modifications in the direction of the line are only those which result from the manner in which the South Atlantic and North Atlantic communicate with each other, it being such that the former contributes a large part of its warm waters to the latter, and so gives it a higher mean temperature.

The Pacific is a vastly wider ocean than the Atlantic, and the lines as they traverse the central waters, lose the most of their obliquity, since the movement is not much evident at the surface. But on the eastern border (the South American side) the cold waters are brought up to the surface by the Continent, as was long since explained by Humboldt. With this difference, the elliptical circuit is as apparent in the direction of the isothermal lines of the North and South Pacific as in the North and South Atlantic. In the *South Pacific*, the position of the isothermal of 68° F. off Australia is in latitude 30° S., and off South America in 2½° N.; and the mean obliquity through the ocean is 10 or 12 degrees. In the *North Pacific*, the line of 68° F. off Japan is in latitude 35° N., and off the North American coast in 21° N.; and the mean obliquity is about 10°. The elliptical circuit in the Pacific, each side of the equator, is therefore demonstrated by the temperature. The Indian ocean exhibits the same facts.

This demonstration for each ocean is independent of the exceptional surface current movements, which give varying and often perplexing results.

It should be observed further, that the temperature of the ocean's surface in the equatorial regions during the colder season

is little above 80° F., while that of the parallel of 50° is as low as 40° F., so that the former is 12° F. above 68° F., and the latter 28° F. below it. And hence unless the waters of the equatorial latitudes very much preponderated in quantity, the effect of the colder waters should be strikingly perceived along the east side of the ocean. In the North Pacific, as the ocean (as well as the globe) narrows north, the equatorial waters do thus strikingly preponderate. But little, if at all, is this the case with the South Pacific, since there is not the same convergence in the borders, and the ocean south of 30° is very free from islands, a fact indicating deeper waters. Besides, in the equatorial regions, the temperature diminishes rapidly in descending below the surface. There is abundant cause therefore for the excessive amount of influence of the cold waters on the western South American coast—an influence which is so great as to exclude a temperature of 68° from the Galapagos under the equator as well as from the tropical American coast very near to the equator.

In my former explanations of this chart, I recognized these circuit movements in accounting for the currents, as they had been laid down by Mr. Redfield. But in accounting for the remarkably low mean temperature of the South Atlantic, I manifestly attributed too much influence to polar waters flowing in from the far south. Now the waters which move eastward in all the oceans—those of the higher temperate latitudes—in this elliptical circuit, move faster than the earth by an amount equal to their apparent rate of motion; and they manifestly could not have derived this velocity from any source but their previous position in more equatorial latitudes where the earth moves faster. No other argument is needed to prove that the eastern movement is a counterpart of the western. In addition to this, since the waters flowing from the polar regions have less motion than the earth near the equator, and therefore are carried against the western side of the oceans, (eastern side of the continents,) as is well understood, (and was fully illustrated, upon the isothermal chart referred to, by the cold current down the Asiatic coast, as well as that better known along North America,) it is not possible that the South Atlantic current which flows towards the equator along western Africa can have accessions from the far south, as such waters would press against South America, the western side of the ocean; and there, in fact, as the chart shows, they do make themselves apparent. Its main supply is in the elliptical circuit itself as above explained.

My object here is not to discuss or dispute actual observations on currents, but to bring out a little more distinctly than has hitherto been done, the argument from the temperature of the ocean itself with regard to the grander points in the system of oceanic movements. The fact that the chart is a winter one for each ocean, does not affect the argument.

Art. XXIX.—*Contributions to the History of Ophiolites.* Part. II;* by T. Sterry Hunt.

In the first part of this paper I have described various ophiolites from the altered Lower Silurian strata of the Green Mts., and I have now to notice the ophiolites of that ancient series of stratified rocks, underlying both the Silurian and Huronian formations, which we have designated as the Laurentian Series.

The crystalline limestones and dolomites of this ancient formation are occasionally associated with serpentine, which is sometimes disseminated in grains through them, or more rarely forms beds, in which the magnesian silicates greatly predominate. The dolomites of this series, unlike those of the Silurian rocks, contain very little oxyd of iron; and the same thing is true of the ophiolites. Hence the serpentines of the Laurentian series are paler in color, and have a less specific gravity, than those which we have already described. My examinations of them have not yet enabled me to detect the presence of either nickel or chrome, which characterize the magnesian rocks of so many other regions. The serpentines about to be described are more tender than those of the Green Mountains, and from their brittleness and pale colors, are less fitted for the purposes of decoration; they also contain a large amount of water, which may in part be hygroscopic.

The ophiolites of this series occasionally enclose small portions of mica and pyrites, and the calcareous ones sometimes contain sphene, and small crystals of phosphate of lime.

1. A calcareous ophiolite from Burgess, discovered by Dr. Wilson, is made up of a pale olive-green serpentine, somewhat crystalline in its texture, intermingled with a little magnesian carbonate of lime, which is sometimes white, and at other times reddish in color. The rock contains besides, some crystals of a greenish white mica, and disseminated pulverulent hematite, giving a red color to portions of the mass. When reduced to powder, it gave to boiling acetic acid, 6·28 p. c. of carbonate of lime, and 3·27 p. c. of carbonate of magnesia. The insoluble residue lost by ignition 14·5 per cent, and then gave to a boiling solution of nitrate of ammonia, an amount of magnesia equal to 0·67 per cent of carbonate, making a total of 3·94 per cent of carbonate of magnesia. The pulverized rock, ignited without previous digestion in acetic acid, and boiled for a long time with nitrate of ammonia, yielded 5·90 per cent of carbonate of lime and 3·84 of carbonate of magnesia, numbers agreeing with the

* See vol. xxv, p. 217.... This paper is extracted with additions, from the Report of the Geological Survey of Canada, for 1856.

preceding, while by the same process the unignited mineral gave 6·30 of carbonate of lime, and a large amount of magnesia.

The residue from the action of acetic acid, including however 0·67 per cent of carbonate of magnesia, gave by analysis:—

Silica,	42·10
Magnesia,	38·94
Protoxyd of iron,	3·69
Loss by ignition,	14·50
	99·23

2. A dull reddish brown ophiolite, from the same locality as the last, likewise contained a small amount of disseminated carbonates, which were completely removed by acetic acid. Thus purified, the matter gave on analysis:—

Silica,	39·80
Magnesia (by difference),	38·40
Protoxyd of iron,	7·92
Loss by ignition,	13·80
	100 00

The dark color and opacity of this rock seem to be due to the presence of disseminated peroxyd of iron, to which some foreign ophiolites appear also to owe their red colors.

3. A pale greenish gray ophiolite, nearly opaque, soft, and earthy in its aspect, occurs at the Calumet Island, on the Ottawa, and being sought after by the Indians, who fashion the stone into calumets or pipes, has given the name to the Island. It contains no lime, but after ignition, yields a trace of magnesia to a solution of nitrate of ammonia. Its analysis showed a mixture of an argillaceous matter; it gave:—

Silica,	37·50
Magnesia,	37·58
Alumina and oxyd of iron,	9·00
Loss by ignition,	15·00
	99·08

4. A white lamellar dolomite from Grenville, which held abundance of honey-yellow grains of serpentine, was examined. Small fragments of the rock were digested with cold dilute nitric acid, and the carbonates being slowly dissolved, the grains of serpentine were liberated, and were found to be only slightly attacked upon their surfaces, which were rendered dull and opaque. The larger grains, some of which were one-tenth of an inch in diameter, were selected for analysis, and gave as follows:

Silica,	44·10
Magnesia,	40·05
Oxyd of iron and alumina,	1·15
Loss by ignition,	14·70
	100·00

The serpentine makes up about one-fifth of the rock. The portion soluble in nitric acid, consisted of carbonate of lime 55·13, carbonate of magnesia 44·87, being a pure dolomite.

5. In this connection I will cite from my Report of 1850, three analyses of serpentines from the Laurentian rocks. I and II are specimens of the retinalite of Thomson, which occurs at Grenville, disseminated in a white crystalline limestone. This serpentine has a hardness of 3·5, and a density of 2·476—2·525; lustre resinous, shining; fracture conchoidal, without any traces of crystallization; translucent; color honey-yellow, passing into oil-green and olive-green. III is a serpentine closely resembling the last, from a similar rock at the Grand Calumet Island; it has a density of 2·362—2·381, and a pale wax-yellow color.

	I.	II.	III.
Silica,	39·34	40·10	41·20
Magnesia,	43·02	41·65	43·52
Peroxyd of iron,	1·80	1·90	·80
Soda,	(*traces*)	·80	—
Water,	15·09	15·00	15·40
	99·25	99·55	100·92

These serpentines, like the others from the same rocks already described, contain less oxyd of iron and a larger proportion of water than ordinary serpentine, approaching in composition to marmolite and deweylite.

Ophiolite of Syracuse, New York.—The rocks of the Onondaga salt-group in the Upper Silurian Series resemble closely those of more recent saliferous formations; they consist of red and green marls, marked by hopper-shaped cavities, and impregnated with sea-salt, and include great masses of gypsum, occasionally with sulphur, and beds of compact argillaceous dolomite, interstratified with others of a tufaceous cellular limestone. These strata are again overlaid by a limestone marked with peculiar needle-shaped cavities, which are ascribed by Mr. Vanuxem, to whom we owe this description, to a crystallization of sulphate of magnesia during the deposition of the rock.

At Syracuse, the strata between two beds of the porous limestones just described, are very much altered; the shales are rendered harder, and some portion of the calcareous rocks have become crystalline and are filled with crystals of celestine and calcite, while other beds are converted into a calcareous ophiolite, a specimen of which I have examined. It agrees closely with the description given by Vanuxem, being an aggregate of grains and rounded masses of serpentine of various sizes imbedded in a greenish gray calcareous base. The colors of the serpentine vary from blackish green to greenish white; it is often translucent, and takes a high polish. Small portions of bronze-colored diallage are disseminated in the ophiolite. Mr. Vanuxem

has also observed among these rocks, the existence of mica in aggregates having the characters of granite, and others in which hornblende replaces the mica, and which he compares to syenite.

He remarks of these metamorphic rocks of Syracuse, that we have here no evidence of igneous action or of the intervention of a dry heat, which he supposes however to be often concerned in alterations of this kind; and he suggests that water, aided by heat to produce the solution of the elements present, might give rise to the results there observed.—(*Report on the Geology of the 3rd District of New York*, pages 108–110.)

I found a portion of this ophiolite in powder, to be readily attacked by acetic acid, which dissolved a large amount of carbonate of lime, besides a little magnesia, and traces of alumina and iron. This proximate analysis gave: carbonate of lime 34·43, carbonate of magnesia 2·73, serpentine insoluble in acetic acid, 62·50, iron and alumina 0·34=100·00. The analysis of the serpentine gave me:—

Silica,	40·67
Magnesia,	32·61
Protoxyd of iron,	8·12
Alumina,	5·13
Water,	12.77
	99·30

No traces of nickel or chrome were detected. A rounded fragment of greenish fine-grained limestone, which was imbedded in this ophiolite, was found to be nearly pure carbonate of lime.

The presence of nickel and chrome, which is so constant in the ophiolites of the Green Mountains, is equally characteristic of the other magnesian strata of the same region. I have found there two metals in small quantities in nearly all the dolomites, magnesites, steatites, diallage and actinolite rocks of eastern Canada. I have also detected them in the serpentines of New Haven, Connecticut, and Hoboken, New Jersey, in a serpentine and a magnesite from California, in the serpentine of Cornwall, (England), and Portsoy, (Scotland), and in those of the Vosges, (France). The presence of chrome which characterizes so many ophiolites, had already been detected by Delesse in the latter locality. I have found it with nickel in a calcareous ophiolite from Corsica, and have also detected nickel in a serpentine from Mt. Rose, and in another from Basta, (Harz). Both nickel and chrome have besides been found by Hermann in the pyrosclerite of Pennsylvania, and by Brush in the antigorite of Piedmont, and the williamsite of Pennsylvania, both of them serpentine. The very frequent occurrence of nickel in the olivines and talcs of various localities has been noticed by Stromeyer and other

chemists. I may here remark that the chrysoprase of Newfane, Vermont, like that of Silesia, is colored by oxyd of nickel.

Vanadium is said by Ficinus to occur in the hydrophite of Taberg, and in the chromiferous serpentine of Zöblitz, while it was found by Schafhaütl in the bronzite of Genoa. The probability of finding vanadium in such associations is increased by the fact that this metal has been found with chromium in the limonites of several localities. It is however by mistake that I have indicated the presence of vanadium in the chromiferous smaragdite of Mt. Rose, and in a chromiferous serpentine from Gaspé, (this Journal, vol xxv, p. 437).

The chrome in the ophiolites of the Green Mts., exists in part in a condition readily soluble in heated sulphuric acid, but in part also as chromic iron, which remains with the separated silica, often associated with magnetite, and in the red serpentines with hematite. The nickel in these rocks appears also to be generally in the state of oxyd, but sometimes occurs in the form of a carbonate, as in emerald-nickel and pennite, and in a magnesite from Sutton, it is in the condition of nickeliferous pyrites.

Ilmenite, rutile and sphene are found in close association with the ophiolites of the Green Mts.; the first forms with magnetite a bed in the serpentine of Beauce, and sphene and rutile are met with in the accompanying chloritic slates, which are sometimes filled with magnetite and hematite, passing into a slaty iron-ore, which is frequently titaniferous. I have detected titanium in the unaltered red slates of this region at Granby, where they are associated with green sandstones and conglomerates, a carbonaceous shale, and an impure limestone remarkable for containing nickel and chrome with titanium. This limestone as described by Sir W. E. Logan in his report for 1847, p. 25, forms two beds of one and two feet in thickness; it weathers to some depth of a chocolate-brown color, from the presence of carbonates of manganese and iron, but has within a dull greenish gray color, and an earthy aspect. When moistened, the mass is seen to consist of a pale green base in which are imbedded darker green scales of chlorite, or perhaps glauconite, which appears to be the green coloring matter of certain Silurian sandstones. The rock in powder effervesces strongly with acetic acid, and a little hydrochloric acid having been added towards the close of the operation, there were dissolved, carbonate of lime 30·08, magnesia, calculated as carbonate, 3·68, oxyd of iron and alumina 5·45, oxyd of manganese ·058=39·76. The residue contained no lime, but portions of chrome and nickel, besides a large amount of titanic acid, amounting in two determinations to 5·3 and 6·2 per cent. The analysis was effected by fusion with carbonate of soda, and gave for 100 parts of the residue insoluble in acetic acid:—

Silica,	53·20
Alumina,	7·90
Protoxyd of iron,	15·75
Magnesia,	8·79
Titanic acid,	6·30
Oxyd of nickel,	·15
Oxyds of chrome, manganese, and loss,	2·45
Soda and potash,	·66
Loss on ignition,	4·80
	100·00

The ophiolites of Cornwall occur, according to De la Beche, among rocks of Devonian age. I have examined a clouded reddish brown and greenish serpentine, containing small grains of diallage, and said to be from the Lizard Point. It gave on analysis:—

Silica,	40·40
Magnesia, by difference,	37·43
Protoxyd of iron and chrome,	7·47
Oxyd of nickel,	·15
Alumina,	·65
Loss on ignition,	13·90
	100·00

I have examined specimens of the following serpentines without detecting the presence of nickel; in their general character all of them resemble the Laurentian serpentines.—

1. Pale greenish yellow granular serpentine, from Easton, Pennsylvania, density 2·501.

2. Fine wax-yellow translucent serpentine, from Montville, New Jersey; it contains veins of beautiful yellowish-white chrysolite, which has a density of 2·435.

3. Pale olive-green serpentine, from Phillipstown, New York; contains no trace of chrome.

4. Dark olive-green serpentine from Munroe iron-mine, New York; contains grains of magnetite but no chrome.

5. Pale green serpentine from Modum, Norway, with ilmenite and magnetite; contains no chrome.

6. Yellowish green serpentine from Newburyport, Massachusetts; density 2·551; this I have shown to be probably of Devonian age.*

Ophiolites have generally been regarded as intrusive rocks. In Southern Europe they occur in injected masses traversing the disrupted nummulitic strata, but they are also found in the same region interstratified with limestones, and with micaceous, chloritic and talcose schists which are regarded as altered triassic strata.† In North America the ophiolites of the Laurentian, Silurian and Devonian formations are all apparently magnesian sediments which have been metamorphosed *in situ*, and never so far

* Am. Jour. Sci., [2], vol. xviii, p. 198
† Coquand, Traité des Roches, p. 112.

as I am aware assume the form of intrusive rocks. The results of Sir W. E. Logan's examinations of the Green Mts. show that the Silurian ophiolites of Canada are the stratigraphical equivalents of a series of silicious dolomites and magnesites, whose alteration has doubtless given rise to the serpentines, talcs, diallages and chlorites. I have already shown that the action of a solution of alkaline carbonate at a slightly elevated temperature upon mixtures of earthy carbonates and quartz suffices to convert the bases of these into hydrous silicates. The same agent has at the same time given rise to the feldspar and mica of the associated strata.

We cannot doubt that rocks permeated by water, assume as Scrope and Scheerer suppose, a pasty condition at temperatures far below that required for their fusion, and if the mechanical conditions of great pressure and the disruption of overlying strata correspond to this semi-liquid state, the altered sediments, ophiolites and limestones, as well as amphibolites and granites, may assume the form of eruptive rocks.*

ART. XXX.—*On the Origin of the Sonorous Vibrations produced under certain conditions by Flames from Wicks or Wire-gauze;* by Prof. WILLIAM B. ROGERS.

IN the latter part of the article on Sonorous Flames, published in the July number of this Journal, it will be remarked that the explanation which is offered of the primary source of the vibrations has reference exclusively to inflamed jets of gas escaping from simple apertures and is not intended to apply to the sonorous vibrations observed in certain cases with flames arising from wicks or wire-gauze. I have indeed endeavored to show that these latter phenomena are directly dependent on the explosive character of the combustion, as in the case of the simple jet, but have not attempted to trace them to a mechanical source anterior to the explosive action. A few remarks on this part of the subject may therefore form a useful supplement to my previous communication.

The mass of gaseous matter which rises from a wick or from the meshes of wire-gauze is to be regarded as made up of innumerable streams variously intermingling and conflicting with one another. It cannot, therefore, be looked upon as the seat of an original and regular vibratory movement due to the discharge of the gas, like that which Masson and others have shown to belong to a simple jet. Nevertheless, it is evident that the flame and contiguous air must be impressed with some degree

* This Journal, vol. xxv, p. 36, and Journal of the Canadian Institute for May, 1858, p. 203.

of vibration anterior to the action of the explosions, as otherwise these would fail to have the periodic character which is necessary for the development of the musical effect.

The conditions under which the wick and gauze flames become sonorous point, as I think very clearly, to the source of these primary or determining vibrations. It will be observed that such flames, in order to become musical, must be placed near the entrance of the tube, and must be large enough to occupy a considerable part of the opening. In these circumstances the strong upward current created by the heat causes the air to enter the mouth of the tube, and traverse the narrow space between it and the flame with sufficient force to generate a feeble musical vibration of the aerial column, such as can at any time be produced by simply blowing from below against and into the mouth of the tube. This vibration although of itself too feeble to produce a decided sound, has the effect of periodically increasing and diminishing the intensity of the combustion, by conveying successively greater and less supplies of atmosphere to the flame. When the explosive stage has been reached, this agency continuing to operate renders the explosions alternately louder and feebler in rapid and uniform succession, and as the pulsations thus produced conform to the harmonic capacities of the tube, there arises a powerful continuous musical sound.

According to this view, the action of the flame in producing the sonorous effect in the case of wick and wire-gauze burners is twofold.

First: It establishes an upward current, and consequently an entering one which operating like a blast applied to the lower end of the tube generates a feeble vibratory movement of the included air.

Second: Its explosive combustion, rendered periodical by the action of the vibrating column, increases the intensity of the vibrations. These again, reacting, augment the difference between the intensions and remissions of the explosion, and thus by a cumulative process the vibrations rapidly attain the strength of a powerful musical sound.

Comparing this with the explanation given in my former paper of the cause of the musical vibration of simple jets, it will be seen that while in the latter case the primary source of the vibration is viewed as *inherent in the jet itself*, in the present instance it is referred to *the column of air in the tube*, but in either case it is the explosive action which strengthens the vibrations so as to produce the decided audible effect. It may be added that simple jet flames, when of large volume are to be considered as acting in part like flames of wick, creating an upward blast and thence a vibratory movement of the air column which combines with the primary vibration of the jet to produce the resulting sound.

Art. XXXI.—*Notes by Lieutenant E. B. Hunt, U. S. A., on a new Sounding Apparatus, proposed by him for Coast Survey use.*

The device proposed has for its chief object to run sounding lines in harbors and water of moderate depth. The principle is that of measuring barometrically the pressure due to the depth, this pressure being transmitted to the barometric basin by a column of atmospheric air.

The method is as follows: Arrange a weighted india-rubber vessel for dragging on the bottom; connect this with a boat or surveying vessel by an air-tight tube of small bore; let this tube open into a cistern of mercury made air-tight; from this cistern arrange a vertical glass column, open at the top, in which the mercury can freely rise to any required height by the pressure due to depth.

The mode of use would be thus: Throw the weighted air-vessel overboard and let it sink to the bottom, it being connected with the vessel by the air-tube, in turn duly joined to the barometric cistern. Let the boat or vessel be propelled on a course. The air-vessel will be dragged along the bottom, and as the water must have free access to the bag enclosing the air, its pressure will compress the air to a density due to the depth. This pressure will be communicated along the tube to the vessel or boat, and being received on the mercurial surface will raise a column to such a height that its weight will equal the weight of an equal column of the water, whose height is the depth to which the air-vessel is sunk, or rather that of the lowest part on which the pressure acts. As this depth varies the height of the column will also vary. The relation of these heights is expressed by the specific gravity of mercury divided by the specific gravity of the particular sea or other water in which the soundings are being made. It would be necessary to make occasional observations with the hydrometer, and in the case of tidal streams these should be quite frequent.

The following is my general idea of the construction of the parts.

The air-vessel should be an easily flexible india-rubber bag, of a pear shape, with a tight neck screw on which to fasten the pipe. Around this bag, a pear shaped metal case must be adjusted, of weight sufficient to sink the air-vessel and connecting tube rapidly. I suppose lead will be the best. The form is important; it should be such as to offer but slight resistance in being drawn through the water. It would be best to throw a large preponderance of the weight on one side of the swelled part, so as to make that side keep towards the ground. The superior forward surface can then be so arranged as to bring into action,

if needed, a component acting downwards and due to the forward dragging. The india-rubber bag should then be fastened to the lower part, so as to compel it always to indicate the pressure corresponding to the same distance from the ground.

The tube should, I suppose, be made of the common patent gas-pipe, (of india-rubber and canvas,) the smallest bore being preferable. This tube must be laid either with wire or fishing-line of such strength as safely to bear the strain. By first laying lengthwise all around the tube a series of wires or twines, and then wrapping them all firmly, the strain of dragging would come almost wholly on the wires or twines, and yet the whole will be quite flexible. If a smaller size of flexible tube which will sufficiently resist inside pressures can be got, it will be better, for as the pressure within will always exceed that from without, the arching stiffness is not required. As the wrapping will greatly reinforce the tube, a moderate strength of the inner tube will suffice. In service, I suppose the tube should be arranged at a number of points for fastening to the boat's or vessel's stern, so that the length out shall be always easily seen. I presume it might very well be dragged at a slope of about $\frac{1}{4}$. All the tube not paid out is to be coiled between the stern and the gauge. By loading the air-vessel the slope at which the tube can be dragged may be increased, or as before indicated, by a head armature or blade, giving a downward component. As the effect of the change of tube slope will be but slight on the horizontal distance between the boat and the air vessel, the sounding at any instant may be taken to belong to a constant distance astern for each of the knots or loops of the tube. Thus a boat or vessel will give a continuous indication of depth along the line over which it passes. It will at once be seen how great an advantage this will give in dragging for bars or shoals along channel ways.

The air-tube is to open into a cistern or basin or syphon branch, connecting with the open-glass indicator or scale tube, the whole to be gimbal mounted, and the tube to be led along the gimbal axes. The graduation can be made differential, so as always to show the inches of pressure. It would probably be on the whole quite as advantageous to have merely a glass tube of about one foot long, fastened on an india-rubber tube, and arranged to slide up and down on a scale, the flexible tube connecting with the fixed cistern. If great depths are attempted with this combination, this will be necessary.

There would be some advantages in using an incompressible fluid in place of air, whose small specific gravity would give a differential pressure. Thus sulphuric ether has sp. grav. = ·715, absolute alcohol do. = ·792, olive oil do. = ·915, whale oil do. = ·923, either of which introduced into the tube and bag, and resting on the mercury would give a tolerable indication,

or if used as the reading fluid without mercury would be perhaps too sensitive. Sea water being of the sp. grav.= 1·026, we see that sulphuric ether will give over three feet on the scale for 10 feet in depth, and whale oil just about one to ten. Linseed oil, sp. grav. = ·940, would be more manageable, and turpentine, sp. grav. = ·991, would, if its fluidity sufficed, be very good. Wine is = ·992, and if it could be kept pure might do, though too little sensitive in fresh water. If we assume that 100 feet is our limit of depth to be sounded, we can readily proceed from this to fix the size of air-vessel required if air is used, or the length of scale in case any of the fluids named are used alone or with a mercurial reading column. There is the objection to these fluids that the height of the cistern level above the sea must be considered, but if air is used this may be neglected. A careful study of their possible combinations will probably indicate substantial reasons for a preference. If air be used, the air-vessel must be so large that it will be supplied with air at the maximum depth anticipated, for which purpose the entire air space of the tube and cistern must bear a less ratio to that of the air-vessel, than the pressure of one atmosphere to the pressure due to the maximum depth in the densest water. The air space being fixed, the weight must suffice to sink this readily, but as it goes down the sinking power will increase, thus partly counteracting the lifting effect of dragging on the sloping tube. If we assume 100 feet as the maximum and $\frac{1}{4}$ the slope, this tube must somewhat exceed 400 feet, and the part out will be varied as the depth, though the whole will be in action as a connection at all times.

These indications may suffice for the simple barometic form. There is, however, a far finer possibility which may be ultimately attained. That is the making this arrangement self-registering. Suppose a sheet of paper made to traverse over a roller, either by watch work or by a mechanism moved by a screw-propeller fixed to the side of the surveying vessel or boat. Then suppose a pencil point connected with a float on the top of the mercurial column, and made to traverse the recording roller as it rises or falls. This would trace a curve of record truly proportional to the bottom dragged. But this arrangement would be difficult and intricate. Suppose, however, that a light fluid is used in the chamber of the drag, the tube and the cistern, and let this cistern be made of shurred or corrugated material, of a long cylindrical form, one head of the cylinder being fixed and the other acting against a spring. If now this moving cylinder-head bear a pencil point traversing the recording roller, it will indicate depths by ordinates which can be read by a fixed scale. I suppose that spring clock work moving a record sheet might be combined with this corrugated cylinder so as to give a record proportional to time without very great difficulty. But the moving of

the sheet by a side propeller, so that the abscissas would be proportionate to the spaces traversed, is very much the most desirable form, and possibly may not present too formidable difficulties. It would doubtless be best to experiment first with the barometric form; and if no unforseen obstacles occur, the greater object can then be maturely considered, and if practicable, fully realized, to the vast advantage of hydrography.

Art. XXXII.—*Lanthanite and Allanite in Essex county, N. Y.*; by Wm. P. Blake.

In this Journal, vol. xvi, Sept., 1853, I announced the occurrence of carbonate of lanthanum at Bethlehem, Pa., associated with ores of zinc. At that place a mass of closely aggregated thin tabular crystals was taken out from an ochery soil overlying a bed of calamine; but though diligent search has since been made at the same place, and at other points in the vicinity, not a single additional fragment has been found, and this interesting species has continued to be almost as rare to mineralogists as when first described.

I have since found the mineral in the town of Moriah, Essex county, N. Y., at one of the openings on the great bed of magnetic iron ore, known as the "Sanford ore-bed." It occurs in a thin crust or layer of small crystals and scales on the walls of fissures in the ore, and, occasionally, upon crystals of allanite.

When examined under a magnifier, the lanthanite is seen to be in thin crystalline plates, and in prismatic masses with a cleavage like that of mica or selenite. On some of the specimens the crystals are brilliant, and contrast finely with the black ore upon which they are spread. Their lustre is pearly, and in color they vary in different specimens from white to a delicate pink or rose tint, thus indicating the presence of didymium.

The magnetite at this locality is associated with phosphate of lime (apatite) in small reddish-brown crystals, known in that region as *red sand*. In portions of the bed it is the preponderating mineral, and is disseminated in belts or layers parallel with the walls.

Allanite occurs abundantly along the plane of contact of the bed of ore with a mass of granitic rock which appears to be different from the true walls of the bed, and may be an intrusion or segregation in its midst. The removal of the ore left a large surface of this granitic wall bare, and allanite crystals were found implanted upon it, in a dark red feldspar and in the iron ore. The crystals are unusually large and perfect, several of them, (of which, however, only fragments were obtained,) could

not have been less than eight or ten inches in length, six or eight broad, and from one to two inches thick. The surfaces of even the largest crystals are very smooth and perfect, and the fracture is conchoidal and highly lustrous. This is without doubt the best locality for obtaining cabinet specimens of allanite yet known in the United States.

The lanthanite at these localities is probably formed by the slow decomposition of allanite. The thin scales and the layers of crystals in the fissures of the iron ore and on the surface of allanite are, to all appearance, the result of the action of percolating surface-water. The beautiful mass of lanthanite in the soil at Bethlehem may have resulted from the decomposition of an isolated crystal or boulder of allanite, which mineral has been found to be abundant in that region.

ART. XXXIII.—*On the Formation of Rotating Rings by Air and Liquids under certain conditions of discharge;* by Prof. WILLIAM B. ROGERS.

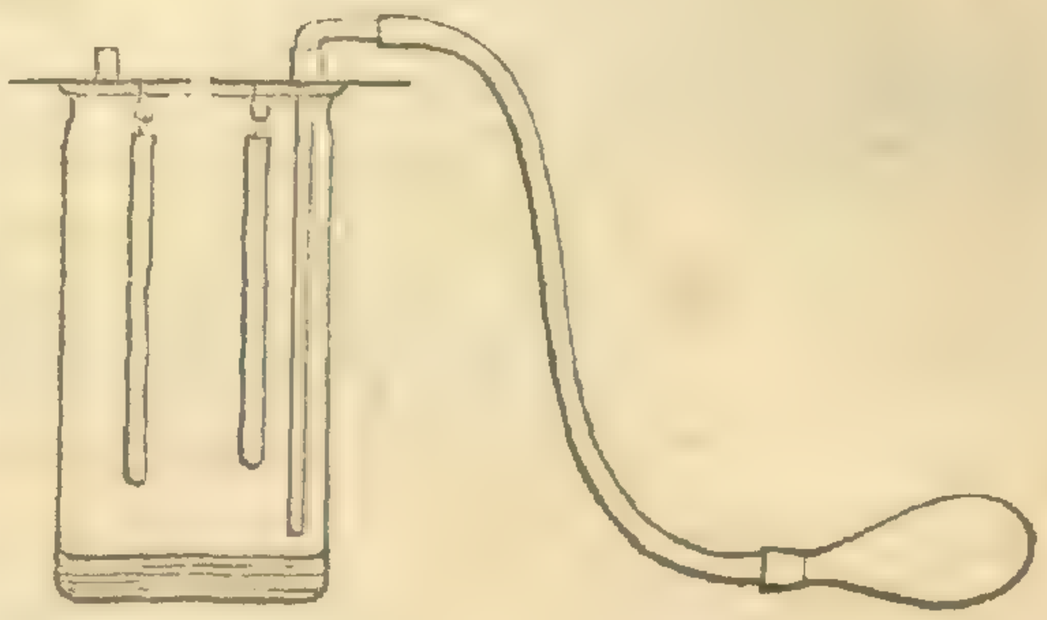
IT has long been a familiar fact that the bubbles of phosphuretted hydrogen gas consisting of PH_3 with an admixture of PH_2, give rise by their explosive combustion in the air to a ring of white vapor-like phosphoric acid, which dilating as it ascends exhibits a rotation of each vertical element around the curved axis of the figure. A similar motion is sometimes discernible in the smoke from a cannon, and in the steam which escapes by momentary puffs from a steam-pipe, and as expert smokers know, such revolving rings are readily produced by ejecting the smoky breath in a peculiar manner from the rounded opening of the lips.

In studying recently the phenomena of air-jets, I have been led to a somewhat critical examination of the conditions under which these ring-discharges are produced. By the use of suitable arrangements I have been able not only to trace the development of the rings produced in air projected from apertures, but to detect similar movements in that which is released by the bursting of an ordinary bubble. I have, moreover, by a modified contrivance succeeded in forming at will similarly constituted rings from water and other liquids, and in tracing them to the same mechanical causes which give origin to the rings of air. As the methods of experimenting which I have adopted, as well as most of the observations, appear to be new, and as the mechanism of these beautiful effects has not, that I am aware, been specially treated of before, I trust that the following details may be regarded as a not uninteresting addition to our knowledge in this department of inquiry.

I. *Of the air-rings formed by momentary discharges from an aperture.*

1. *Mode of producing the air-rings.*—To render the form and internal movements of the escaping air in such cases distinctly visible, I use a large glass reservoir, (fig. 1,) in which the air is kept opaque by a continual supply of chlorid of ammonium generated within. To the top of the jar is adapted, by grinding and an unctuous cement, a zinc or glass cover pierced with three holes, viz.: a central round aperture one inch in diameter, and two others of much smaller size, each furnished with a short socket-tube rising above the plate. Of these, one is intended for connection with tubes of discharge, and is kept closed when the central orifice is in use. The other receives a slender glass tube, entering above by a rectangular bend and descending to within two inches of the bottom of the jar. At its outer end this is connected with a flexible pipe through which the operator, impelling the air in successive puffs into the lower part of the vessel, can at will eject corresponding volumes of the cloudy air through either of the apertures. For this purpose he may either use the mouth, or a gum-elastic bag attached to the end of the tube—the former being in most cases the preferable instrument. At equal distances on opposite sides of the central hole, two hooks are affixed to the lower surface of the plate, from which are suspended long slips of thick cotton cloth.

1.



To prepare the apparatus for experiment, we remove the cover and pour into the jar common hydrochloric acid to the depth of half an inch, adding to it one or two cubic inches of nitric acid. The slips of cotton cloth, after being dipped in strong water of ammonia, are replaced on the hooks, and the cover restored to its position with a slight pressure to render the junction firm and air-tight.

The included air quickly becomes opaque with the dense cloud of chlorid, and by applying the lips to the free end of the flexible tube may be expelled from the aperture which is left unclosed, either in the form of successive puffs or of a continuous jet. It is almost needless to say that in making the experiment the surrounding air should be as little moved as possible, the slightest agitation near the aperture sufficing to mar the symmetry of the effect.

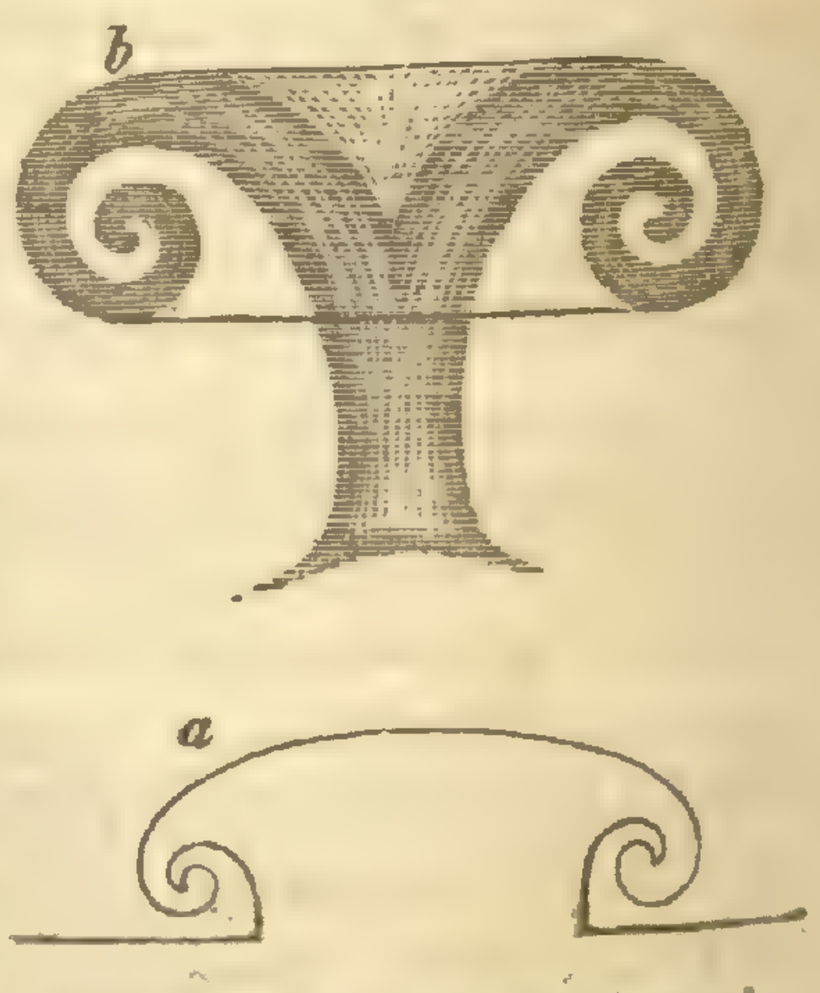
2. *Stages of the ring-formation.*—When by a moderately strong impulse the cloudy air of the jar is made to issue in a succession

of quick but not violent puffs, each little cloud assumes near the aperture the form of a ring, which gradually dilating as it rises retains its symmetry until it has reached the height of two or sometimes even of three feet above the opening.

Using a gentler and less sudden impulse we cause the ring as it ascends to carry with it a train of cloudy air *which forms the downward continuation of the inner portion of the coil.*

With a still lighter breathing at the mouth-piece we may expel the air in so gentle a wave as to be able to mark the escaping cloud rolling slowly over on each side of the aperture without breaking its connection with the central mass—the whole thus assuming the appearance of the top of a column adorned with volutes. In this experiment no actual ring is generated, but we have the opportunity of watching the beginning of such a form and tracing the mechanical movements to which it owes its development. In fig. 2 the earliest stage is indicated by *a*, and the imperfectly formed ring with part of the attached train by *b*, the lateral sections of the ring only being represented.

2.



When the discharge is produced by a stronger impulse than in the case first mentioned, the resulting ring darts upward so rapidly as to break away from its train, leaving the latter either to lag behind as a formless mass, or, when retaining sufficient velocity, to evolve from its own substance a second and smaller ring which is seen quickly pursuing the first. By applying a yet more energetic force, we may cause the ejected air to form three, four, or even a greater number of such successively developed rings.

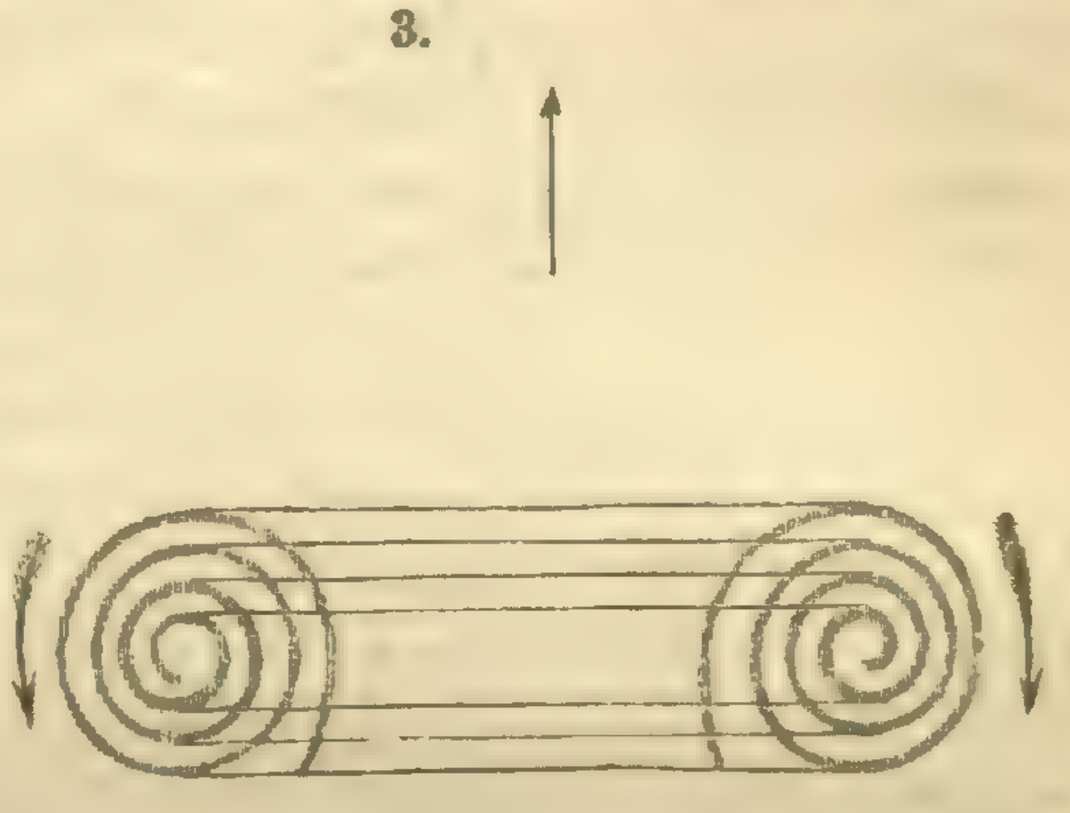
The size of the ring when first formed is dependent chiefly on the width of the aperture, and in some degree also on the strength of the blast. With a hole one and a half inch in diameter, and a proportionally large injecting tube, it is easy, by a suitable impulse of the breath, to generate rings of from two to three inches in diameter of the most perfect symmetry, and having force enough to ascend unbroken to a height of six or eight feet. In this way we may render these beautiful phenomena visible over a large apartment, causing the smoky wreaths to chase each other until flattened against the ceiling.

If instead of the mouth we use the elastic bag as a means of impelling the cloudy air, we find that a quick pressure and subsequent withdrawal of the hand give rise to rings of great symmetry, and that these are usually unaccompanied by any train.

The latter result is evidently due to the sudden recoil of the bag, and the consequent retraction of the latter part of the cloudy mass back into the reservoir. By continuing the pressure so as to prevent the recoil we may produce the same phases of the phenomena as when the impulse is given by the breath.

3. *Rotation and structure of the air-rings.*—To obtain a distinct view of the motion and internal structure of the ring, it should be viewed in a nearly horizontal direction, and by a strong transmitted light. This is conveniently done by placing the apparatus on a table a little below the level of a gas lamp, but at a considerable distance from it. It will then be seen that the rotation of the ring, either in its incipient stage, or with the attached train, or when entire and separate, has always one direction, the inner circumference being carried forwards or in the ordinary mode of experiment upwards, and the outer in the reverse direction, as shown in fig. 3. In order that the eye may readily follow this motion in the interior of the ring while it retains its perfect form and rapid rotation, the air of the reservoir should be only moderately cloudy, and the impelling force quick without being violent.

3.



Under these circumstances we observe *the ring to be made up of a coil of cloudy air—between the folds of which is rolled up a similar coil of transparent atmosphere.*

When the ring carries a train it is easy to discern that the cloudy spiral is continuous with this attendant mass, and really issues from it near the inner circumference of the ring. In a yet earlier stage of the action we are able to mark the beginning of this two-fold spiral by observing how each volute as it draws its supply from the central mass gathers in a portion of the clear external air to be enfolded between its turns.

4. *Origin of the rotation.*—This is obviously referrible to the combined agency of the outward impulse and the resistance which the sides of the issuing mass encounter from the edge of the opening, and from the air into which it is impelled. The former of these forces, due to the tension propagated through the reservoir, must to some extent operate in diverging directions, while the resistance acts in nearly opposite lines. Thus, at the outset, there would be produced a reversion or curling of the issuing cloud around the aperture, which, as the action continued, would be developed into the spreading volutes before described, and at length into the perfect and rapidly revolving ring.

The dilatation of the ring in its ascent would seem to be the natural result of the divergent character of the impulse impressed upon the air as it passes from the orifice.

5. *Horizontal bands of the ring.*—On examining a ring in which the clear and cloudy spirals are plainly distinguished, it will be found to have the appearance of *alternating layers or bands of cloudy and comparatively clear air arranged horizontally*, but which are most strongly marked towards the top and bottom of the ring, and cease to be discerned near the middle. When the air employed is only moderately cloudy, and the rings are large and perfectly developed, this banded appearance is admirably brought out by a mild transmitted light, and adds not a little to the beauty of the revolving and expanding wreath.

It is easy to see that this apparent structure is an *optical illusion* due to the passage of the light alternately through a greater and a less thickness of the cloudy lamina of the composite ring. Thus it will be observed (fig. 3) that the rays coming to the eye in the horizontal plane which passes through the upper part of the cloudy spiral will be much more obscured than those which pass in a parallel plane through the clear space immediately beneath, the former having to pass lengthwise through a considerable distance in the cloudy layer, while the latter traverse little more than twice its thickness. The same relations must hold for the next inner turns of the spiral, but as its circuit grows narrower the difference between the aggregate of clear and cloudy portions passed through must continually grow less, and near the equator of the ring become quite insensible; hence the bands which are so distinctly marked towards the top and bottom of the ring disappear as we approach its midway line.

6. *On the effects produced by a continuous blast.*—By slightly *prolonging* the impulse either from the mouth or the bag so as to expel a comparatively large amount of the cloudy material at a moderate velocity we are able to mark the partial formation of a second ring in the swollen part of the train which still adheres to the first, and even of a third yet more imperfect one in the train prolonged below the second, the whole still forming a united mass.

With a *continuous and uniform blast* of moderate force the appearances are even more curious and instructive. The column in this case retaining its smooth cylindrical outline for only a short distance above the aperture, presents higher up along its sides, and at nearly equal intervals, a succession of whorls or volutes, more and more developed as we ascend, and which not unfrequently terminate at the top in a nearly perfect and separate ring, (fig. 4,). On urging the blast with a much increased velocity these lateral markings of the column become less conspicuous, and assume throughout, nearly to the summit, the aspect of a

series of short projections curving steeply downwards, like the lowest and least developed volutes in the preceeding experiment.

On examining these lateral gyrations as shown in the figure it will be seen that each is formed at the expense of the adjacent parts of the column both above and below it. The central arrows pointing divergingly upward indicate the direction in which the inner portions of the stream are deflected to unite with the wider part of the spiral; the exterior arrows directed downwards mark the relatively retreating motion impressed by the resistance acting at the sides, and show the course of the particles passing into the spiral from above.

4.

It would seem that these movements must have the effect, superficially at least, of dividing the column into alternate tracts of rarified and condensed air, the former situated about midway between the successive coils, and the latter directly above where the coils unite with the main mass. These regular alternations, virtually equivalent to a system of waves or vibrations generated in the effluent stream, indicate the analogy in condition of large streams of gaseous matter, and the slender jets in which such vibratory movement has already been demonstrated, and point to one of the agencies which may be concerned in the latter phenomena. They at least furnish conclusive proof that *even a large stream of gas discharged under a steady pressure does not flow with continuous uniformity, but becomes the seat of periodical movements at equally recurring intervals.*

II. *Of the motions of the air produced by the rupture and by the explosion of bubbles.*

As the beautiful rings developed by the explosive combustion of phosphuretted hydrogen gas are formed under the influence of far more energetic forces than are brought into play by the rup-

ture of a bubble of common air, it becomes important to determine what kind and amount of effect is due to the simple bursting of the bubble independent of any explosive action. I have, therefore, made numerous experiments on bubbles of common air rendered cloudy as in the previous experiments, and have been much interested by discovering that in all such cases *a distinct rotary motion is produced corresponding with that of the air rings already described.*

7. *Mode of experimenting with floating bubbles of air.*—In order to observe the movement of the air occasioned by the bursting of the bubble I use a deep glass bowl, into which is poured a layer of water containing soap enough to give durability to the bubbles when formed on its surface. A finger bowl of the largest size answers for this purpose. Placing this on the table near the ring apparatus (fig. 1) previously charged with very opaque air, I attach to the tubulated aperture of the jar a flexible pipe terminating in a glass tube of about one-tenth inch in diameter. Dipping the end of the tube into the soapy water so that it may take up a short column of the liquid, I hold it centrally over the water and close to the surface. Then breathing carefully into the mouthpiece, provided for this purpose with a narrow opening, I form a floating bubble of any size from a half inch to three inches in diameter. This being done the glass beak is to be gently lifted away, and the bowl covered with a glass plate, brought over it with a sliding motion. The bubble must now be left undisturbed for fifteen or twenty seconds, to allow its contents and the air of the bowl to come to rest, at which time the suspended cloud will be seen to have subsided a little from the apex, showing a level surface above.

As it is necessary for a satisfactory observation that the rupture of the bubble should begin exactly at the top and extend symmetrically around that point, and as in the spontaneous bursting this only occasionally occurs, it is expedient not to wait for the rupture but to force it by means of a wire inserted vertically through the apex and quickly withdrawn, the glass cover having first been removed by a gentle sliding motion. When this has been done so as to avoid agitation we see a cloudy column rising some inches above the liquid, and rolling over in delicate volutes at the top.

With a bubble of from one to one and a half inches in diameter the symmetry of the resulting column is quite striking and *its correspondence in motion and shape with that already described as an early stage of the ring formation is not to be mistaken.* In many cases a perfect and almost separate ring is developed at the top, and when the air is not too opaque the alternate coils and the resulting horizontal bands are perfectly distinct. But

from the feebleness of the rotation these appearances are only momentary. When the bubble is two or three inches in diameter, the outward and downward curling at the top of the cloudy mass is still quite observable, although much less marked than in the preceding case. When very small bubbles are broken, the motion is too quick and the cloud too small for satisfactory observation.

(8.) *Origin of the rotation.*—It thus appears that in the mechanical rupture of a floating bubble forces are brought into play similar in kind and general direction to those operating on the ring-discharges from an orifice. Of these, one is evidently the *tensional action of the liquid film* driving the cloudy air through the opening, another is the *resistance of the adjoining air* into which the mass is impelled. The former corresponds in effect to the tension propagated through the reservoir in the previous experiments, the latter is the same in both cases; and we may consider the widening aperture of the bubble through which the air is thus as it were squeezed, as answering to the orifice on the top of the jar.

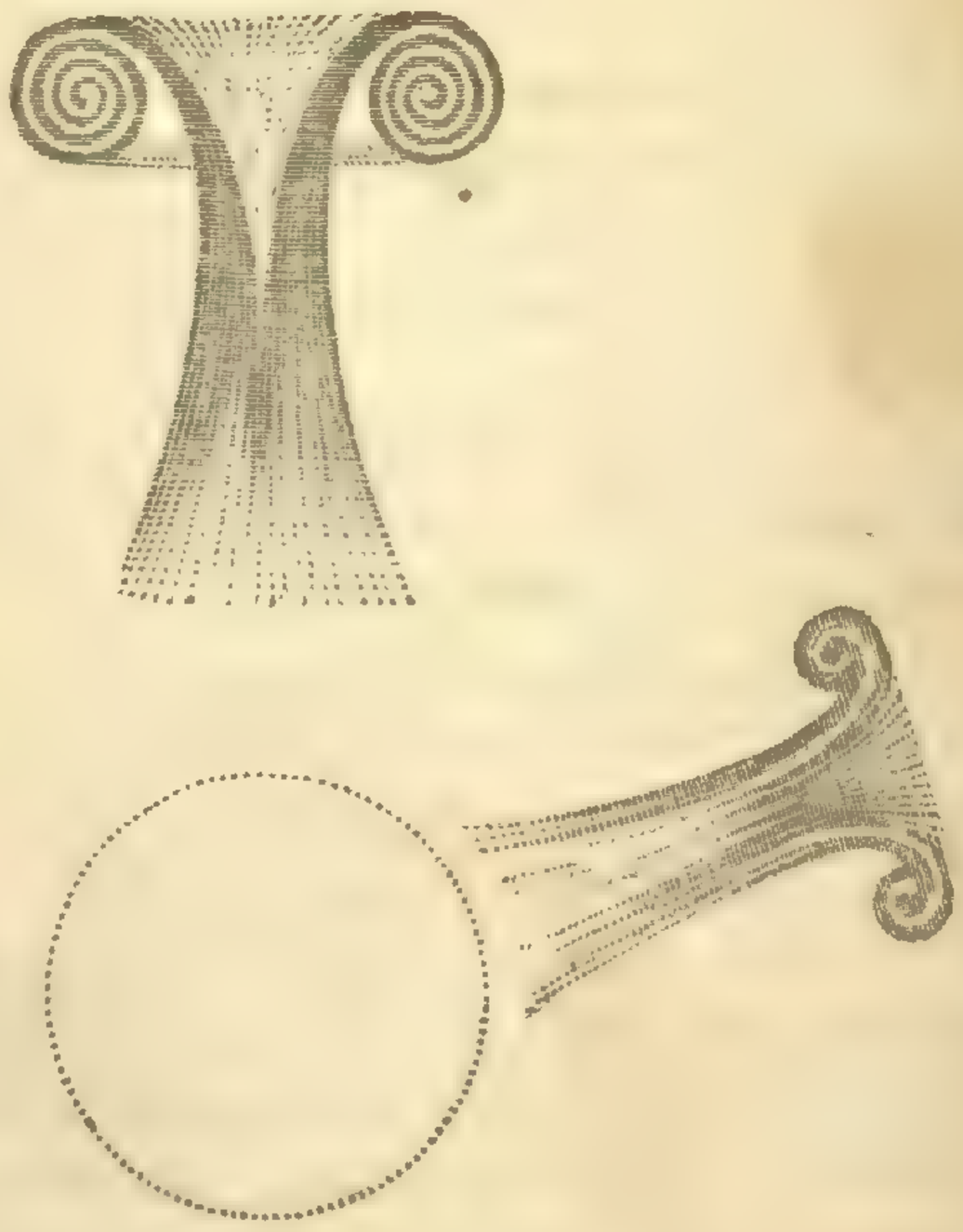
This view of the mode of action of the film is confirmed by the very curious effect which results when the bubble is punctured on one side. Thus applying the point of the wire near the base we see the cloudy column rushing out in a nearly horizontal direction on that side. If we pierce the bubble at an intermediate height the air is projected obliquely upward towards the hand. It can hardly be doubted therefore that in all such cases *the bubble is destroyed by a progressive and regular enlargement of the opening first made, and that this takes place with sufficient slowness to allow the aperture to give direction to the extending force.*

(9.) *Rings generated from spherical bubbles.*—The effects just described are produced in a still more striking degree by the rupture of bubbles of completely spherical form. In this as in the former experiments the utmost care must be taken to protect the adjacent air from agitation. With this view the bubble as soon as blown should be deposited at the bottom of the glass bowl, on a piece of soft cloth or a flake of carded cotton, and left undisturbed for ten or fifteen seconds. On piercing it at the top with a very slender wire *we see its contents suddenly projected upwards some inches*, forming a cloudy column whose summit rolling over on all sides develops *a beautifully distinct ring* which at times ascends so rapidly as to separate from the general train.

The effect is best seen with a bubble of from three-fourths to one inch in diameter. When the contiguous air is perfectly quiescent the ring retains its form even above the top of the bowl, affording a clear though momentary view of its twofold spiral and the resulting horizontal bands, as well as of the direction of its rotation. When pierced at the side instead of the

apex, the bubble, as might be expected, projects its contents towards that side in the direction of the wire, showing though less perfectly the same configuration. Both effects are rudely indicated in fig. 5.

5.



As these experiments on the rupture of bubbles will be found to have much interest, I may suggest that they can be easily repeated by forming the bubbles with tobacco-smoke blown from the stem of a common pipe, from which they are readily transferred to the soapy water as spherical segments or to the cloth surface as entire spheres. But it must be remembered that even a slight motion of the contiguous air will defeat the observation.

I need scarcely add that the tensional action of curved films of liquid, so strikingly shown in these phenomena, has been illustrated by Prof. Joseph Henry in a series of interesting experiments of which an account was published some years ago.

In the present case the most important inference to be drawn from the results is that the destruction of the bubbles proceeds not from a subversion of cohesion irregularly throughout the film, but from a uniformly progressive enlargement of the opening first formed, by the continuous retraction of its edge.

(10.) *Of the rings produced by floating bubbles of phosphuretted hydrogen gas, when exploded.*—In what has just been stated we mark the effects simply of the mechanical rupture of the bubble, calling into play as a motive agent the tensile force of the film, or what is equivalent, the expansive action of its contents released from the pressure under which they have been held. But in the present case the rupture has no sooner begun than a chemical action of great intensity sets in between the included gas and the air. This commencing usually at the apex and extending downwards and laterally *in a symmetrical manner* gives rise to a powerful expansive force having an obliquely upward direction on all sides. The products of the combustion are thus impelled into the contiguous and comparatively quiescent air under conditions very analogous to those of an energetic momentary discharge from the ring apparatus of the former experiments. The resistance at the sides of the ascending and spread-

ing column, combining with the upward impulsion of the interior will, therefore, give rise to *a similar rotation of the cloudy mass*, rolling it up into the spirally constructed ring in which it presents itself at the close of the explosive action.

It will be remarked that these explosive rings are more rapid in their expansion as well as their rotation than the rings produced by mechanical discharge, a result due doubtless to the greater energy of the forces by which they are developed. As might be expected, rings of the latter kind approach more nearly to the former in these particulars when a vigorous impulse is applied in producing them.

In most cases the wreath of phosphoric acid is so opaque as to preclude the examination of its interior structure, but when more diluted, we are able to trace within it, as in the other rings, the two-fold coil of cloudy and clear atmosphere.

In experimenting with the explosive bubbles every one must have noticed the frequent occurrence of irregularities and failures in the production of the ring. This is a natural consequence of the rupture beginning on the side or at more than one spot, instead of commencing at the apex of the film, and accordingly in such cases it will be remarked that the flame and smoke dart out laterally, producing a broken and almost formless wreath.

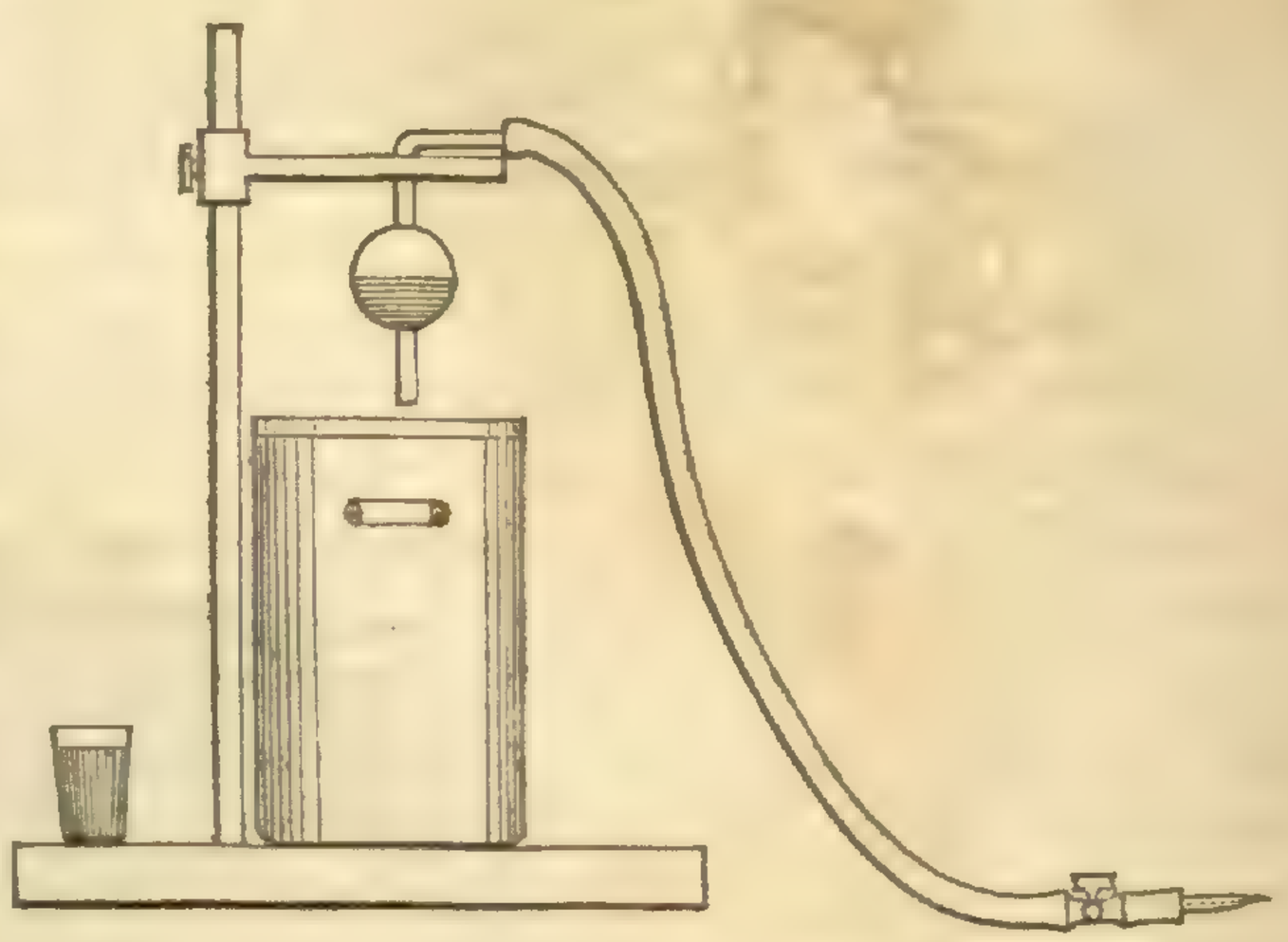
III. *Of the formation of liquid rings.*

The production of liquid rings by a succession of drops, although only of occasional occurrence, has doubtless often been observed in the course of laboratory manipulations. Yet so far as I am aware no attempt has hitherto been made to determine the structure and movement of these rings, or the precise conditions under which they are generated. My attention having been called to this class of effects by some remarks of Prof. Horsford on the rings formed by precipitated sulphate of lead, I was led after various trials with this and other precipitates to discard the chemical action as irrelevant to the particular effect in view, and to employ as a dropping-liquid water charged with some coloring substance, either suspended or dissolved. Among the materials thus used may be mentioned chromate of lead, carbonate of lead, sulphate of lead, sulphate of baryta, cobalt blue and dilute solution of sulphate of indigo. Of these, the two first and the last yield perhaps the most perfect results.

11. *Production of liquid rings by drops.*—A convenient apparatus for these experiments consists of a globular pipette (fig. 6, see next page) of about two inches in diameter, mounted on an arm which is capable of turning easily in a horizontal plane, and a large cylindrical vessel filled with clear water nearly to the brim. The beak of the pipette, about an inch in length, has a smoothly

ground aperture of one-tenth inch. The upper tube, bent at right angles, is fastened into a flexible pipe about eighteen inches long, to the outer end of which is adapted, by means of a small stopcock and short gum-elastic tube, a slender tube of glass drawn to a fine capillary bore.

6.



In order to charge the pipette, we revolve the horizontal arm into a convenient position, and bring the small vessel containing the colored liquid up to the beak. Then slipping off the coupling tube we apply the lips at the stopcock, pump up the charge and quickly closing the stopcock replace the coupling and capillary tube. After one or two drops have fallen the flow ceases and the pipette may be brought round over the centre of the reservoir. By opening the stopcock either partially or wholly we have perfect control over the rate of discharge, and can make the drops succeed each other as slowly as we please.

It should be observed that air bubbles carried by the drop into the liquid produce an irregular motion, destructive of the desired effect. Hence the beak should be placed only a short distance above the surface. An interval not exceeding one and a half inches usually answers very well, but at a distance of from one half to one inch admirably uniform results are obtained. Indeed, it is not necessary to the effect that the drop should reach the surface with any sensible velocity, as a well-formed ring will be produced by simply *laying the drop upon the water* from the closely approached beak of the pipette.

As it is essential to a perfect experiment to have the liquid of the reservoir as motionless as possible, its mass should be large, and it should be allowed to come to rest after each drop before the next is allowed to impinge upon it.

Operating with these precautions, and viewing the result from a point a little lower than the level of the fluid, we see that the drop, soon after merging in the liquid, gives origin to a ring of exquisite symmetry, which rotates and enlarges as it descends, precisely after the manner of the gas-rings already described. In some cases the ring, continuing unbroken through the whole depth, spreads out on the bottom a flat annulus of the heavy

coloring matter. But usually, after reaching a distance of four or five inches, it breaks up with a peculiar outward uncoiling motion, forming at intervals of the circuit flattened spaces, from the outer points of which the pigment is seen dropping in numerous slender streams.

12. *Motions and structure of the liquid rings.*—The rotation of the liquid ring on its circular axis is directed upwards on the outer circumference and downwards on the inner; or viewed in relation to the progression of the mass, it presents an advancing movement of the inner and a retreating movement of the exterior periphery. It is thus identical with the rotation of a gas-ring impelled in a descending direction.

The liquid ring, moreover, resembles that of gas in being composed of a coil of colored fluid enfolding a parallel uncolored coil. Indeed, when sufficiently translucent, it exhibits quite distinctly the horizontal bands which, in the case of rings of cloudy air, have been shown above to be an optical result of this twofold structure. The correspondence between the phenomena is rendered still more complete by the fact, that the liquid ring is followed by a residuary colored mass, which, when the forming impulse is feeble, remains attached to it as a train.

13. *Formation of liquid rings by impulsive discharge.*—The observed identity of motions and structure in the two classes of rings led me to attempt the production of liquid rings by a mechanical process similar to that used in forming the rings of air. For this purpose I lowered the beak of the pipette so as to immerse it a little below the surface of liquid in the reservoir, and closing the stopcock applied a sudden and transient pressure of the fingers to the flexible tube. The experiment was eminently successful. The colored liquid thus discharged was seen to shoot downwards in the form of a very perfect ring, in all respects resembling those above described, except that its rotation and expansion were more rapid. Modifying the arrangement, by attaching to the stop-cock a small but thick gum-elastic bag, I have found it easy to regulate the impulse so as to develop the rings as slowly as may be desired, and thus to reproduce with the colored liquid all the stages of the phenomena previously marked in the case of rings of air. In this way, by a gentle and rather gradual force, I can cause the escaping fluid to roll up into lateral volutes, or, increasing the action, to form the opening ring with its attached train; or, by a yet quicker and stronger impulsion, I can compel the ring to shoot rapidly away, leaving the train either to break up irregularly or to form by its own motion a second smaller ring, as in the case of discharges of air.

The rings thus formed in the midst of the liquid will, of course, differ in size, according to the amount of liquid expelled at each impulse. As, however, this is never so small as a drop, and

the velocity of the action is comparatively great, the rings thus formed are always larger than those resulting from the dropping process. They are, therefore, better suited for observations on the internal motions and duplicate structure of the liquid ring. It is essential in such observations, however the ring may be formed, to make use of a partially transparent liquid, such as a dilute solution of sulphate of indigo, or a thin mixture of cobalt blue, and to view the ring by a moderately strong light. In these circumstances the double spire and the horizontal bands become beautifully apparent.

14. *Origin of the liquid ring, and of its rotation.*—Considering the entire agreement in structure and motions of the liquid ring as compared with the mechanically formed ring of air, it is natural to conclude that similar conditions of force are concerned in their production. Such is evidently the fact with rings generated by the process last described, that is, when the orifice is at or below the level of the reservoir. Here, the impulse of discharge acting downward and laterally, and the resistance of the aperture and of the contiguous medium acting backwards, present a combination of forces precisely such as, according to the previous explanation, operates in the production of the rings of air.

In regard to the formation of rings by the dropping process, the mechanical conditions, although apparently different, are such as I think would naturally give rise to the same combination of motions. In considering the mode of action of the drop it is proper to distinguish between the case of a drop which *impinges upon the surface* of the medium with a sensible velocity and that of one *simply laid upon it* from the beak of the dropping tube. The former strikes the medium with the acquired momentum, and penetrating into it as if through a circular aperture, forms an advancing column whose central parts are carried forward, while the sides are relatively retarded by the resisting action of the contiguous fluid. Under these conditions, the forces brought into play and their resulting motion must evidently be the same as in the case of an impulsive discharge of liquid from the immersed beak of the pipette.

In the other case, that is, where the drop is simply laid upon the liquid plane, the gravity of the matter of the drop and the tension of the curved surface unite in giving a downward impulsion to its contents. At the same time, the surface of contact with the fluid beneath, forming, as it were, a rapidly enlarging circular aperture, secures the symmetry of the moving mass. This, as it advances, will of course be subject to the same moulding action of the impulsive and retarding forces which has just been described, and which, as we have seen, imparts to rings of air and water formed by mechanical discharge their identity of structure and motion.

Art. XXXIV.—*Correspondence of M. Jerome Nicklès, dated Paris, June 30th, 1858.*

Equivalents of elements.—Dumas has given us reason to expect from him a work on the various questions connected with equivalents and atomic volumes, upon which he first published in 1822. While looking forward to the full publication, he has just communicated to the Academy some new results of his researches.

Among the simple bodies or elements studied by him, 22 have equivalents that are multiples of hydrogen by a whole number; viz:

O	8	N	14	Bi	214	C	6	Li	7	Cd	56
S	16	Ph	31	Fl	19	Si	14	Na	23	Sn	59
Se	40	As	75	Br	80	Mo	48	Ca	20		
Te	64	Sb	122	I	127	Au	92	Fe	28		

Seven have equivalents which are multiples of *half* an equivalent of hydrogen.

Cl	35·5	Mn	27·5	Ni	29·5	Pb	103·5
Mg	12·5	Ba	68·5	Co	29·5		

Three have equivalents which are multiples of *one-fourth* of an equivalent of hydrogen.

Al	13·75	Sr	43·75	Zn	32·75

Among the comparisons that may be made there are the following:

N / Fl	14 / 19	Ph / Cl	31 / 35·5	As / Br	75 / 80	Sb / I	122 / 127

It is seen that on adding 108 to the number for nitrogen we have the number for antimony (14+108=122); and adding it to the number for fluorine, we have the number for iodine (19+108=127).

So also on adding 61 to the equivalent of nitrogen we obtain that of arsenic (14+61=75); and the same to that of fluorine, gives that of bromine (19+61=80).

In a word, if the numbers be arranged on two parallel lines, the ordinates of one series lengthened by 5, become the ordinates of the other, with the single exception of phosphorus and chlorine, which are separated by 4·5 instead of 5. These facts teach the propriety of arranging the metals in series, that shall show a double parallelism; for such a classification brings out to view the various analogies existing among them. In fact, when arranged by natural families, each of the elements is in proximity to two others, belonging to two related families; and these related families occupy the two lines next to that containing the metal selected for comparison. Finally, each metal is surrounded in such a table by four others, which are united to it by analogies of different kinds and more or less close.

Artificial minerals.—By the reaction at a high temperature of volatile fluorids on certain oxygen compounds, Messrs. H. St. Claire Deville and Caron have easily obtained large crystals of white and green corundum, ruby, sapphire, zircon, chrysoberyl, spinel and staurotide. The last, a silicate of alumina, was obtained in two ways; either by decomposing fluorid of aluminium by silica, or fluorid of silicium by alumina. The

general method may be explained by a brief statement of that for white corundum.

Into a carbon crucible put some fluorid of aluminium; and over it adjust a small carbon cupel filled with boracic acid: then having put on the cover and protecting the crucible from the action of the air, subject it to a white heat for an hour or so. The vapors of the fluorid and boracic acid, meeting in the free space in the crucible over them, decompose one another, and afford corundum and fluorid of boron. The crystals are rhombohedral with the prismatic and basal planes of a hexagonal prism; they are optically negative and have all the other physical qualities of corundum. Large crystals over a centimeter long and very broad have been obtained, but they want thickness.

To form the ruby or red corundum, it is only necessary to add a little fluorid of chromium to the fluorid of aluminium: and the blue corundum or sapphire is obtained under the same circumstances, the only difference being that it contains extremely little of chromium in some unknown state. With much oxyd of chromium, the corundum is of a fine green color.

Permian rocks in North America.—On the 10th of May last, the Academy of Sciences received a letter from Dr. Shumard, announcing his discovery of Permian fossils in the Guadalupe Mountains, New Mexico. M. d'Archiac observed on the reading of the communication, that the first identification of the Permian in the Rocky Mountains, was due to a Frenchman, Jules Marcou, who was connected with an expedition under Captain Whipple in 1853, which crossed the Rocky Mountains from the Mississippi to the Pacific through New Mexico. The rocks were observed by him to the northwest of the locality mentioned by Dr. Shumard, between the River Colorado Chiquito (lat. 35° 18′ 43″, long. 110° 49′ 56″), and the Sierra de Magoyon, underlying a series of beds referred to different stages of the Trias; the beds were a magnesian limestone and he compares it to the magnesian limestone of England. Its thickness was about 325 yards; the fossils, although abundant, were too imperfect for determination.*

M. d'Archiac added further, that Prof. Emmons has also referred to the Permian System certain deposits in North Carolina that lie below rocks of the age of the Richmond coal bed. He has even found the lower jaw of a species of Insectivorous mammal (Dromatherium sylvestre), with remains of thecodont Saurians in the Chatham coal basin of the same state, below beds containing plants which he refers to the age of the "Marnes irisées" (upper Triassic). But as nothing seems to prove that the beds are really older than the overlying marls, this mammal may be no older than the *Microlestes antiquus* of Wurtemberg.

* Note by the Editors.—This claim for Mr. Marcou we believe is quite unfounded. Any geologist knows that pronouncing upon the age of a rock, in an unexplored region, on mineral characters alone, or without well determined fossils is no credit to the reputation of a geologist. Marcou has given in his report no evidence from fossils as to the so-called *Permian*. Moreover the species of fossils, out of which he has made his *Jurassic*, have been shown to be *Cretaceous*, and his *Triassic* was based on no better evidence than his Permian. The whole was a hazardous guess; and as far as facts have been ascertained not right at that for the particular localities visited by him. We shall touch on this subject again in our next number.

Oysters: resupplying the oyster banks of France.—The trade in oysters in France has so declined that unless there is some speedy remedy, it will soon entirely cease. Out of 23 banks of oysters which have been in successful exploration on the coast of Rochelle, 18 have been completely ruined, and the others injured, by the invasion of muscles. The same is true of other beds along the Atlantic and Mediterranean shores. The French government proposes to undertake the resupplying of the beds, and we cite the following from the Report on the subject by the Zoological Section of the Academy of Sciences.

Each oyster may produce 1,000,000 to 2,000,000 of young. If, out of this number, twelve remain on the shell of the mother, it is all that can be expected in years of abundance. The number that becomes attached is therefore almost nothing compared with the number lost; and the problem consists in finding a means of detaining this small proportion of the ova at the bottom for the purpose of peopling it. The following method has been put in practice by several amateur zoologists, and among them, by Mr. Carbonnel, Mr. Mallet and Mr. Ackermann. It consists in letting down over the beds a frame work made of branches stripped of their bark, and spread out flat so as to be no obstacle to navigation. The brood of developed ova will rise like a cloud of powder across these entwined branches, and the embryos encrust them on all sides. The frame-work is to be left in place not only during the time of reproduction, but, until the young are sufficiently large to be removed for peopling other beds. The pieces of frame-work thus loaded with young may be carried by vessels wherever desired. After some time, the young shells will detach themselves and fall to the bottom which had been previously prepared for them by means of the drag. This transfer should be made in February or March, because at this time, the young oysters deposited on the branches of the frame-work are large enough to be easily seen.

The dragging for oysters in France usually begins in the month of September. The commission propose to make February or March the time for opening the fisheries, for when, in July, it is attempted to ascertain which beds are in a condition to be opened, all the oysters have not yet laid their eggs, and the product from those which have is not visible to the naked eye.

The government has not yet determined on any course of action; but as a commencement, has given the Report general publicity, in order to draw to it the attention of practical men.

Garden for the Acclimation of Animals.—The "Société Zoologique d'Acclimatation" has been till recently without any convenient grounds in the vicinity of Paris. Paris has now appropriated to the Society 15½ hectars (nearly 40 acres) of the "Bois de Boulogne," with the commission to form a society for establishing and sustaining a zoological acclimating garden, for multiplying and supplying to the public, species of animals or plants, useful or otherwise desirable, which have recently been, or may hereafter be, introduced into the country. To obtain capital for the society, it has made an appeal to all who may be ambitious of adding to our stock of animal or vegetable wealth. The sources of income will be,

1st, the proceeds from tickets issued to visitors to this garden of rare and strange plants and animals; 2dly, the proceeds from the sale of animals, eggs, plants or grains obtained in the establishment or by its means, which will all be of ascertained purity and at the same time very rare.

The past history of the Society of Acclimation is a sufficient warrant for its future success. A few of its services may here be mentioned. In 1854 it purchased half of the only herd of yaks which had come to Europe; and now the yak, through its care, has become acclimated without difficulty, and has prospered. In 1855 it distributed nearly a million of bulbs of the yam (*Dioscorea Batatas*); now the yam is cultivated at large over Europe, and it promises to rival the potato, when through successive sowings it shall have lost its long form. The Society has spread everywhere the Sorghum sugar cane, (*Holcus saccharatus*,) which already furnishes to the departments of middle and southern France abundant forage of good quality, while at the same time, through its saccharine juices, it promises to be as valuable to the southern provinces of France as the beet to the northern. It has procured young plants of the *Loza*, a species of *Rhamnus*, from which the Chinese extract the fine green color called the *Kao*. It has imported two herds of Angora goats, which reproduce perfectly in Europe without manifesting any symptoms of degenerating. It has not only acclimated the silkworm of the Ricinus, (*Bombyx Cynthia*, or Palma Christi silkworm, a native of India,)* which is already in France to its 25th generation, but it has done more, in succeeding in varying its nourishment, by substituting the leaf of the very common *Fuller's Teasel* (*Dipsacus Fullonum*) for the Ricinus (*R. Europœus*) which is rare and does not grow in our climate without great care; and it has almost succeeded in regulating the time of hatching, so as to make the birth of the worms correspond with the development of the leaves on which they are nourished. It has already nearly accomplished the propagation in the open air of a silkworm living on the oak. It has raised in the Jardin des Plantes two new kinds of Chinese oaks. It has undertaken to grow the white nettle of China, with which fabrics may be made more firm than those of linen or the indigenous hemp. It has promoted the culture of the oleaginous pea, excellent as food and affording an abundant oil. It has received in portable green-houses the wax tree and varnish tree in good condition, with the insects which frequent them. Finally, through M. D. de L'Huys, its Vice President, it has succeeded in procuring from the slopes of the Cordilleras numerous tubercles of potato, in order to renew in Europe this so valuable species, which through exaggerated culture and long-continued disease has lost a part of its qualities.

If all these results have been secured, without even a small garden, what may be attained when the society shall have secured large grounds, where men shall be constantly devoted to raising, multiplying, studying and improving new species that may be introduced, and where the public shall be able to see and avail themselves of the great success?

Alcohol from Sorghum.—We return to a subject of which we have often spoken to mention a new fact. M. Leplay has been investigating the Sorghum (Holcus saccharatus). He has experimented on more than a thousand kilograms of it, and has continued his labors for two months.

* See this Journal, [2,] xix, 108, and xx, 288.

He has recognized, 1st, that the quantity of solid matter which the stems of Sorghum give on drying augments gradually and quite regularly, from the formation of the panicle (flowering) to the maturity of the grain, whatever the soil; 2d, this solid matter accumulates in the juice and not in the insoluble part of the plant; 3d, when the stem is still green and the panicle scarcely formed, it contains only a little sugar; the sugar is developed as the plant advances and the grain approaches maturity, and hence the composition of the stem and the production of the saccharine matter depend entirely on the state of the plant, and not on the epoch of its cultivation; 4th, in the juice of the Sorghum, before its maturity, in which the saccharimeter can discover little or no sugar, fermentation indicates between 32 and 100 grams of sugar per litre; but as the grain advances towards maturity, there is a gradually increasing deviation to the right in the polarizing apparatus, caused by the cane sugar present, and when the grain is ripe the quantity of cane sugar indicated by the polarizing apparatus is but little less than the sugar indicated by the fermentation.

On desiccation, the Sorghum loses 70 per cent of its weight. In this state it can be preserved, and so used in the manufacture throughout the year. Mr. Leplay carries on the fabrication with little cost, and observes that it is easily done with apparatus that may be carried from place to place.

Angora Goats.—The acclimation of the Angora goat* has been completely accomplished. The goat is now living and at large in the Vosges, Jura, Cevennes, Alps, mountains of Auvergne and Aveynon, and the Black Forest. It prospers marvelously in Algeria, as the Report before us attests. The Angora goat was introduced there in 1856; the flock consisted of ten individuals, four males and six females; it has so prospered as to consist now of forty-six individuals, eighteen males and twenty-eight females, and none are at all degenerated from the original stock; the silky hair has lost nothing of its lustre, and affords fine velvets every way comparable with the silk velvets, and even superior to them, as it does not mat with pressure or friction. M. Bernis, veterinary of the army in Africa, to whom this flock has been intrusted, proposes to produce a mixed breed between the goat of the country and some of the females of the Angora, (which are in excess in the flock,) and so establish a new variety. The trial has already been made in France, and a mixed breed obtained of very rustic appearance, with hair inferior in quality to that of the pure Angora.

Electric discharges produced in air highly rarified.—On making a current of static electricity to pass through a tube of rarified air, a luminous arc is obtained, which experiences modifications when subjected to the action of the poles of a powerful magnet. This fact, which calls to mind the corresponding effect experienced by a luminous arc produced by a powerful galvanic battery, was discovered by De la Rive in 1849. He first used as the source of the electricity the hydro-electric machine of Armstrong, afterwards a common electric machine, and quite recently Ruhmkorff's apparatus. M. Plücker, of Bonn, has tried the same, and his results are published in a recent number of Poggendorff's Annalen.

According to De la Rive, it is necessary for success that the tube or globe should contain some vapor, equivalent in tension to six millimeters

* See this Journal for November, 1855, p. 405.

of mercury, and the vapors answering best are those of alcohol, sulphuret of carbon, and camphene. De la Rive has applied the experiments to the illustration of the Aurora Borealis, so frequent in the Polar regions. A recent discovery has been made, bearing on this theory, by Dr. Robinson, who has found that the light of the Aurora Borealis possesses the property of rendering substances fluorescent which are susceptible of it. The material on which he experimented was sulphate of quinine.

On raising sunken vessels.—In a former communication, some years since, we spoke of the experiments made by Messrs. Fèvre and Giannetti towards raising by means of balloons filled with carbonic acid sunken vessels or other bodies. Carbonic acid was proposed because it could be so easily procured. But a civil engineer, Mr. Marrassieh, has proposed to employ atmospheric air, and his apparatus has had the approval of many good judges. The object has long engaged much attention and has had its interest greatly enhanced by the war in the Crimea. The new system has consequently been made the subject of a Report by the Academy of Sciences, which is quite favorable, and from which we cite a few words.

The air balloons proposed by Mr. Marrassieh are made of the prepared caoutchouc called artificial leather. They are carried to the bottom empty, and secured to the sunken object by divers, and then they are filled with air by forcing pumps, worked by means of steam upon a steamboat—an indispensable auxiliary in such operations.

A girt of these balloons is put around the submerged body, the balloons being united together by tubes; but there are stopcocks to shut off the communication between them, so that accident from rupture is confined to the one in which it may occur.

Anesthesis by carbonic acid.—We have explained, during the year past, the experiments of Simpson and Follin on the use of carbonic acid for local anesthesis. We now have to report on the effects of its inhalation when mixed with a certain quantity of air, as observed by Mr. Ozanam, who proposes its use for man. He states that the effects of carbonic acid are quite similar to those of ether, but more fugitive; and while with the latter, the inhalation should be interrupted at intervals, with carbonic acid, the reverse is true. He affirms:

a. As long as it is wished to prolong the sleep the inhalations should be continued.

b. They may be continued ten, twenty, thirty minutes and more, without danger to life.

c. On ceasing the inhalation, waking is almost immediate.

In these experiments no case of sudden death has been observed, as with chloroform. When death is in prospect, as Dr. Fèvre has observed, it comes slowly, and may be foreseen for a long time in advance, and its progress noted, according to his experience, by the state of the heart and that of the pupils. The following experiment, reported by Mr. Ozanam, is highly interesting:

"I prepared a gas-bag containing 100 litres of carbonic acid, and resolved to continue the anesthesis as long as was possible. The animal was asleep at the end of three minutes without convulsions, and so remained, extended on its side. The inhalations were continued for eighty-seven minutes, and then the apparatus was withdrawn. The sleep was prolonged afterwards for five minutes; towards the tenth minute the legs commenced to

shake; at the fifteenth the animal was up again; and thus 102 minutes were used in the whole experiment—a length of time much beyond what the longest operations would require."

Messrs. Fèvre and Ozanam have respired the gas several times,—if not to the production of sleep, at least to feeling its first effects. They say its taste is slightly pungent, and as agreeable as that of ether; it excites salivation. They propose its adoption in surgical practice, as the least dangerous method, and as sufficiently efficacious.

Variation of color in the venous blood of the glands.—Since the discovery of the circulation of the blood, it has been admitted that the blood of the arteries is red and that of the veins black, with this exception that it is the reverse for the arteries and pulmonary veins. This fact has afforded Bichat the foundation for his grand division of the circulation, (since adopted by all anatomists,) a vascular system with *red* blood, which carries the blood from the lungs to all parts of the body; a vascular system of *black* blood, which carries the blood from all parts of the body to the lungs. But it results from the researches of Prof. Claude Bernard that this statement cannot be accepted absolutely. This skilful observer has proved, through a great number of dissections of living subjects, and in a manner which leaves no room for doubt, that the blood contained in the renal veins is sometimes black and sometimes red, and that when it has the latter color, it is black in the inferior vena cava which receives the blood from the renal vein.

This fact being established, he looked for an explanation, and found that it was due to the state of repose or activity of the kidneys, the secretory organ of the urine. He has, in fact, demonstrated, by delicate experiments, in his course of Physiology at the College of France, that when the urine runs from the kidneys, where it has just been formed, in the ureter which takes it to the bladder, the blood contained in the renal cavities is red; and that it becomes black when the flow ceases.

The same experiment performed on the submaxillary gland of the dog produced the same result. Flowing of saliva by the proper duct from this gland, and presence of red blood in the afferent vein are two phenomena which go together, as also the absence of saliva and black color of the blood in the same vein. Analogous experiments made on the parotid gland and on the glands in the abdominal parts of the digestive tube, have given similar results. But the author adds, with the habitual severity which he brings to his conclusions, that the study will be complete only when the examination shall have been extended to every gland throughout the structure.

It results from the facts, that if, as regards physiological conditions, the term *red blood* may be applied to the *arterial blood*, that of black blood cannot be used in so general a way for the venous blood. It results also from other researches of Prof. Bernard that physical and chemical modifications correspond to these different states of coloration, and ought to be taken into consideration in the analyses of the blood, the composition of which varies even with the state of activity or repose of an organ. This last principle applies not merely to the glands, but to all the organs of the body, so that it will be necessary to study now the venous blood in the state of repose, and in the state of functional activity. It is worthy of remark that if the blood goes out red from the glands in activity, it

goes out, on the contrary, very black, and with different physical qualities from a muscle which contracts itself.

In experimenting on the submaxillary gland, Prof. Bernard has been able, by means of electricity, to excite at will the activity of an organ, so as to produce the secretion of saliva and the coloring of the blood of the vein red. This fact suggested to him the following remark: "All those modifications which the blood undergoes in consequence of the functional activity of the organs, are always determined by the nervous system; and consequently, at this point of contact between the organic tissues and the blood, we must search for a knowledge of the special agency of the nervous system in the physico-chemical phenomena of life."

Society for the Aid of the Friends of Science.—This Society, the formation of which we announced last year, as the suggestion of Mr. Thenard, held its first session on the 15th of last April. It is in full prosperity and numbers now 1400 subscribers. It has already aided many persons in need, and gives an annual pension to four families of men of science, among them those of Laurent and Gerhardt. No condition of residence is prescribed to Madam Laurent or Madam Gerhardt, who were not born in France, and they are therefore free to go where they choose, without losing the right to the pension. Madam Laurent is of the Duchy of Luxembourg, and Madam Gerhardt of Edinburgh, Scotland, a daughter of Dr. Sanders. It is probable that these ladies will not take advantage of the privilege, but will remain in France, to superintend the education of their children which is given gratuitously in a department of the University.

Since the death of the President, Thenard, another has been elected, and the officers are now as follows:

President, Marshal Vaillant, Member of the Institut.—*Vice Presidents*, Dumas, Flourens, and De Senarmont.—*Secretary*, De Senarmont.—*Vice Secretaries*, Barreswill and F. Boudet.—*Censors*, E. Delessert, Baron Seguier, Paul Thenard.—*Treasurer*, Paul Seguin, Civil Engineer.

Besides, the Society has a Council of Administration in which some scientific and industrial notabilities figure,—among them, Elie de Beaumont, Boussingault, Geoffroy St. Hilaire, Poncelet, Dolfus, (President of the Industrial Society of Mulhouse), Schattenmann, (Director of the Manufacture of Chemical Products of Bouxwiller, Bas-Rhin), etc.

The "Compte Rendu" of this year will soon be published with a list of the subscribers.

Bibliography.

MALLET-BACHELIER, *Paris, has recently published:*

Annales de l'Observatoire, vol. iii, in large 4to.—This volume contains a Treatise by Yvon Villarceau, On the determination of the Orbits of Planets and Comets, and two by LeVerrier entitled *Theory of the Periodic Comet of* 1770, and *Construction of tables of the Movements of the Planets.*

Cours d'Analyse de l'Ecole Polytechnique par Sturm, publié par Mr. Proutret, vol. i, in 8vo.—This first volume is a reprint of the Lectures of Sturm in the Polytechnic school,—lectures which have had great reputation.

Tables de Logarithmes à 5 decimàles, par Hoüel, 1 vol. in 8vo.—These tables which are in part a reproduction of those of Lalande have been

made more convenient for use by several modifications derived from works published in other countries.

HACHETTE, *rue Pierre Sarrazin, Paris.*

Du Moncel: Etude du Magnetisme et de l'Electro-magnetisme, 1 vol. in 8vo.—This is the only work which is completely up to the most recent discoveries or published experiments in electro-magnetism, a department which has been made a subject of special study by the author.

Général Morin: Aide-Mémoire de Mecanique pratique, 2nd edition, 1 vol. in 8vo.—This work is indispensable to constructors, mechanicians, and even to physicists. It contains the principal formulas useful in practice, besides information on the subjects of density, friction, dilatation, resistance of materials, etc.

Gustave Heuzé: Matières fertilisantes, engrais solides, liquides, naturels et artificiels, 1 vol. in 8vo.—This work is a publication of the Course of practical Agriculture which Professor Heuzé gives with great success at the celebrated School of Agriculture at Grignons.

Alfred Maury: La Terre et l'Homme, in 12mo.—Contains information of indispensable importance in Ethnology, Geology, Mineralogy, Species and Races, and Geography in general.

At the BUREAU DE L'AMI DES SCIENCES, 9 *Rue Cassette, Paris.*

Victor Meunier: Essais Scientifiques, 2 vols. in 12mo.—V. Meunier is the founder and director of a weekly sheet entitled *L'Ami des Sciences*, (The Friend of Science), which aims to popularize the more important scientific facts. The two volumes entitled *Scientific Essays* have for their object the scientific reconstruction of society and the removal of abuses, which are connected according to the author with education. The author writes with extraordinary fervor, touching upon great questions and bringing out cruel truths. He entitles the first volume, "Apostolat Scientifique." The second treats of the improvements to be brought about in Architecture, Agriculture, and Navigation. It is impossible to read a work written with so much earnestness, without interest.

Louis Aubert, Civ. Eng.: Sur les Moyens de préserver les Navires des desastres causés par les Abordages, a pamphlet with lithographic illustrations.—Mr. L. Aubert is admitted to be the inventor of the floating batteries which contributed so much towards ending the war in the Crimea. This new memoir contains a continuation of the ideas which were published by him in 1852 on the occasion of the work just alluded to.

At Strasbourg, at the Bookstore of DERIVAUX.

Zoologie du Jeune Age, ou Histoire Naturelle des Animaux, par A. Lereboullet, Professor de Zoologie à la Faculté des Sciences de Strasbourg.—This work, written especially for youth, is an attractive exposition of the principal facts relating to the Natural History of Animals. The beautiful plates colored by Silbermann's process, contribute much to increase the interest of the volume, the first two parts of which have been issued. It will be adorned by 320 colored figures of animals, and will appear in 32 parts, at 50 centimes (or about 10 cents) each.

V. MASSON, *Place de l'Ecole de Médecine, Paris.*

J. Nicklès. Le Moteur des Convois des grands tunnels, et en particulier du Tunnel Sous-marin, a pamphlet of 32 pages in 8vo.—The subject of this work has been indicated in our last communication.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On the Nature of Flame, and on the Condition of the Sun's Surface;* by JOHN W. DRAPER, M.D., Professor of Chemistry and Physiology in the University of New York.—(L., E. and D. Phil. Mag., vol. xv, p. 90.)—Among the recent publications on photo-chemistry, there is one by Professor Dove on the Electric Light (Phil. Mag., Nov., 1857) which will doubtless attract the attention of those interested in that branch of science. Examination by the prism, and by absorbing and reflecting colored bodies, leads him to the conclusion that it is necessary to consider the luminous appearance as having two distinct sources:—1st, the ignition or incandescence of the material particles bodily passing in the course of the discharge; 2dly, the proper electrical light itself. As respects the first, he illustrates its method of increase from low to high temperatures, by supposing a screen to be withdrawn from the red end of the spectrum through the colored spaces successively towards the violet; and that of the latter from the bluish brush to the bright Leyden sparks, by a like screen drawn from the violet towards the red.

The true electric light exhibits properties resembling those observed in actual combustions, as though there was an oxydation of a portion of the translated matter when the spark is taken in air. The order of evolution of rays in this instance happens to be the same as in the second illustration of Professor Dove, that is, from the violet to the red. There are certain facts connected with these appearances of color which are not generally known, and deserve to be pointed out.

In the Philosophical Magazine, (Feb., 1848,) I showed experimentally that there is a relation between the color of a flame and the energy with which the combustion giving rise to it is going on. The more vigorous and complete the combustion, the higher the refrangibility of the light. A flame burning in its most tardy and restricted way, emits rays that are red; but burning in its most complete and effective manner, rays that are violet. In intermediate states of combustion, the intermediate colors are evolved in their proper order of refrangibility.

The flame of a candle or lamp consists of a series of concentric luminous shells, surrounding a central dark core. These shells shine with different colors, the innermost one immediately in contact with the dark core being red, and having a temperature of 977° F. Upon this, in their proper order of refrangibility, are shells the light of which is orange, yellow, green, blue, indigo, violet. When we look upon such a flame, the rays issuing from all the colored strata are received by the eye at once, and impress us with the sensation of white light.

The differently colored shells of which a flame thus consists, may be easily parted out from one another, and demonstrated by a prism. Their cause is the slower rate at which combustion occurs at points more and more towards the interior. On the outside, which we may say is in contact with the air, the combustion is most vigorous and complete, and hence the light there emitted is violet; but in the most interior portion of

the shining shell, resting upon the dark combustible matter, the atmospheric air can hardly penetrate, or rather its oxygen is exhausted and consumed. Between the exterior and interior surface, the burning is going on with an activity constantly declining, because the interpenetration or supply of oxygen is gradually less and less.

But besides this collection of colored shells, constituting what may be termed the actual flame, there is another region exterior thereto, and to be distinguished both in its chemical nature and in its optical relations. Chemically, it consists of the products of combustion and of the unburnt residue of the air, that is to say, carbonic acid, steam, and nitrogen. These are all the time escaping out of the true flame, and envelop it as an exterior cone or cloak. Optically, this portion differs from the true flame in the circumstance, that it is shining as an incandescent, ignited, but not a burning body. For physiological reasons, into the detail of which it is not necessary here to go, the tint of this exterior cloak seems to be a monochromatic yellow. That, however, is to a considerable degree a deception, prismatic examination proving that all the other colors are present, and that the yellow merely exceeds the rest in force or intensity.

A flame thus far may be considered as offering three regions:—1st, a central nucleus, which is not luminous, and consists of combustible vapor; 2dly, an intermediate portion, the true flame, arising from the reaction of the air and the combustible vapor, and being composed of a succession of superposed shells, the interior being red, the exterior violet, and the intervening ones colored in the proper order of refrangibility; the cause of this difference of color being the declining activity with which the combustion goes on deeper and deeper in the flame. As to temperature, the inner red shell cannot be less than 977° F., and the exterior violet one probably more than 2500° F. 3dly, an envelop consisting of the products of combustion, exterior to the true flame, shining simply as an incandescent body, and its light for the most part overpowered by the brighter portion within.

By the aid of the facts thus presented, we can easily explain the nature of the other regional divisions distinguishable in such a flame. There must be a blue portion below; blue, because it consists of the most refrangible rays, which issue forth in abundance, for there the exterior air is most copiously and perfectly applied. At the upper end of the flame, particularly if the wick be long and the supply of combustible matter abundant, the light emitted is red, for the products of combustion ascending past that part, make it difficult for the exterior air to get access.

Upon these principles we may also predict what color a flame will have when we vary the circumstances of its burning. Tallow or wax at temperatures greatly beneath their usually understood point of combustion, oxydize with a pale violet phosphorescent light, quite perceptible nevertheless in a dark room; and here the light is violet, for the supply of combustible matter is small, and that of the air abundant. The oxydation is therefore thorough and prompt. For a like reason, sulphur, as we commonly see, burns blue; but if a piece of it is thrown into nitrate of potash ignited in a crucible, the light yielded is of intolerable brilliancy,

and absolutely white. Its whiteness does not depend upon the physiological fact, that any color, if it be intensely brilliant, will seem white to the eye; but it is optically white, as is proved by prismatic examination, when all the colors are perceptible. And the reason of this is, that at the high temperature to which the sulphur is exposed, it volatilizes faster than the nitrate of potash and air together can oxydize it, and offers every intermediate rate of combustion, and emits rays of every refrangibility.

In like manner it may be shown that carbonic oxyd must burn with a blue flame, and cyanogen with a red. We can also foresee what must be the optical result of resorting to unusual methods of combustion, as when we throw into the interior of a flame a jet of air from a blowpipe. In this case we destroy the red and orange strata, replacing them by bluer colors. Examining such a blowpipe cone by the prism, we have a beautiful demonstration that such has actually taken place.

There is one of these special cases which deserves attentive consideration in connection with the appearance of the electric light: it is the production of Fraunhoferian lines, when things have been arranged in such a way that an incombustible material is present in the substance to be burnt. This state is perfectly represented in the case of cyanogen, which contains more than half its weight of incombustible nitrogen. When the peach-colored nucleus of the cyanogen flame is properly examined, it yields a series of dark lines and spaces exceeding in number and strength those of the sunlight itself. These fixed lines are the representatives of dark shells, superposed among the shining ones with definite periodicity. In such a cyanogen flame they bear no relation to the burning of the carbon, but must be attributed to the disengagement of the nitrogen.

In other cases dark lines are replaced by bright ones, as in the well-known instance of the electric spark between metallic surfaces. The occurrence of lines, whether bright or dark, is hence connected with the chemical nature of the substance producing the flame. For this reason they merit a much more critical examination than has yet been given them, for by their aid we may be able to ascertain points of great interest in other departments of science. Thus if we are ever able to acquire certain knowledge respecting the physical state of the sun and other stars, it will be by an examination of the light they emit. Even at present, by the aid of the few facts before us, we can see our way pretty clearly to certain conclusions respecting the sun. For since substances which are incandescent, or in the ignited state through the accumulation of heat in them, show no fixed lines, their prismatic spectrum being uninterrupted from end to end, it would appear to follow that the luminous condition of our sun, whose light contains fixed lines, cannot be referred to such incandescence or ignition. At various times those who have studied this subject have offered different hypotheses: one regarding the sun as a solid or perhaps liquid mass in a condition of ignition; another considering the light to be electrical; a third supposing it to be the seat of a fierce combustion. Of such hypotheses we have given reason for declining the first. Prismatic analysis, which demonstrates no resemblance between the light of the sun and that of any form of electric discharges with which we are familiar, enables us in like manner to reject the second; and upon the

whole, facts seem most strongly to prepossess us in favor of the third, in artificial combustions similar fixed lines being observed. If such is to be regarded as the physical condition of the sun, we can no longer contemplate it as an immense mass slowly and tranquilly cooling in the lapse of countless centuries by radiation into space, as so many considerations drawn from other branches of science have hitherto led us to suppose, but it must be regarded as the seat of chemical changes going on upon a prodigious scale, and with inconceivable energy.

If the law designated above, that the more energetical the chemical action in combustion the more refrangible the emitted light, be translated into the conceptions of the undulatory theory, it not only puts us in possession of a distinct idea of the manner in which the combustive union of bodies is accomplished, the quickness of vibration increasing with the chemical energy, but it also enables us to transfer for the use of chemistry some of the most interesting numerical determinations of optics.

2. *Fluosilicates and Fluostannates.*—MARIGNAC has found that the fluo-silicates are isomorphous with the fluo-stannates. The fact is regarded as demonstrating that the formula of silica is SiO_2 in place of SiO_3.

3. *On Fluorescence produced by the Aurora;* by T. R. ROBINSON, (in a letter dated Armagh, March 24, 1858, and cited from the L., E., and D. Phil. Mag., xv., p. 326.)—On the 14th instant an aurora was visible here of more than the average brightness. At 11 P. M. it showed an arch extending from W. to N.E. by E., which emitted a few yellow streamers; and the sky above it was covered with diffused light, over which brighter portions flickered like waves, extending several degrees beyond the zenith. I availed myself of the opportunity to try whether this light was rich in those highly refrangible rays which produce fluorescence, and which are so abundant in the light of electric discharges; and I found it to be so. A drop of disulphate of quinine on a porcelain tablet seemed like a luminous patch on a faint ground; and crystals of platinocyanid of potassium were so bright that the label on the tube which contained them (and which by lamplight could not be distinguished from the salt at a little distance) seemed almost black by contrast.

These effects were so strong in relation to the actual intensity of the light, that they appear to afford an additional evidence of the electric origin of this phenomenon, and as such I hope they may interest some of your readers.

4. *The Air-balance, a new form of Barometer, for weighing atmospheric fluctuations;* by J. B. JAMES, M.D.—Reflection upon the action of a barometer said to have been in use for some time past in the observatories of Liverpool and Rome, which has that portion of the tube not immersed balanced upon a lever, the motion of which indicates the changes, has suggested an arrangement which it is believed is new, and by which minute changes in the pressure of the atmosphere may be weighed with great accuracy.

Let the barometer tube be fixed over a platform, with its lower end freely exposed; let the platform also support a balance, one arm of which being placed directly under the lower end of the tube, supports the reservoir containing the surplus mercury; in this the lower end of the tube is immersed in the usual manner. If now the other arm of the balance be weighted, to counterpoise the reservoir and the mercury not supported

by the atmosphere, the alteration which change of atmospheric pressure renders necessary in the counterpoise, indicates the change of pressure which has occurred.

Several circumstances require attention, besides delicacy in the balance and accuracy in the weights, to secure accuracy in the results. 1st. The tube must be of uniform capacity throughout its length, excepting so much as is immersed in the mercury; varying capacity in the different portions of the tube will be productive of error by the alterations which change of temperature produces, even if the vacuum chamber be uniform. 2d. An alteration of either the temperature of the mercury or the atmospheric pressure, will require a re-adjustment at each successive observation by elevating or depressing the support of the balance or the tube in such manner as to cause the immersion of the tube in the mercury to the same point to which the first adjustment was made; the immersion of more or less of the tube will cause an error in the result. For this purpose two balances may be used; upon one the tube may be balanced in the manner first alluded to, by which the point of immersion is determined, the reservoir-balance being fixed in its normal position for that purpose; the tube-balance being now fixed, the other is freed and brought to the same position by weights: thus the mercury need not be seen in any part of the operation. This adjustment would probably be facilitated if a short piece of iron or platinum tube of small diameter were attached, which would displace less mercury and prevent to some extent a fluctuation of the column of mercury caused by the motion of the balance. 3d. If very great accuracy is desired, it may be requisite that the arms of the balance be symmetrical and bear equal and similar surfaces, so that change of temperature or atmospheric pressure, the accumulation of dust, oxydation of mercury, &c., may affect both sides equally. Variation of temperature will cause an alteration in the diameter of the tube, and be productive of a small error, for which no remedy is suggested.

This instrument, it is obvious, may be so adjusted as to indicate the pressure of the atmosphere in pounds and its parts on the square inch of surface. But as it will often be desirable to compare observations made by it with those of other instruments, it will generally be required that it express the height of the column of mercury: to this end the instrument may be adjusted to a pressure equal, say, to thirty inches of mercury at a temperature of 32° Fahr. If now a tube has been used having a capacity of 1000 grs. of mercury at 32° F. for an inch of its length, which would have a diameter of about ·6 of an inch, each grain will represent the thousandth part of an inch; and if a correction has been made for the capillarity of the tube, all its indications, at whatever temperature, will represent the height of the column at 32° F., and require correction only for the altered diameter of the tube.

A rude instrument has been constructed on the principle here indicated. A barometer tube having a capacity of 100 grs. to the inch, or a diameter of ·18 inch, was suspended over the dish of a U. S. post-office balance, upon a peg, by turning which the tube was adjusted to the surface of the mercury in the reservoir; and this rested upon the dish. Its operation was such as to justify the foregoing conclusions. Of course a scale may be attached which will show in the usual manner the height of the column.

II. MINERALOGY AND GEOLOGY.

1. *Lecontite, a new mineral;* by W. J. TAYLOR, (Abstract from "Mineralogical Notes" in Proceedings of Acad. Nat. Science, Philadelphia.)—This new and interesting mineral is remarkable as being a double sulphate of ammonia and soda with potash, containing two equivalents of water and yet homœomorphous with the group of anhydrous sulphates. Prof. Dana has very kindly made the annexed measurements of two crystals which I sent to him soon after receiving the mineral from Dr. LeConte. I made a verbal communication on the subject before the Academy of Sciences at Philadelphia on the evening of February 16th, but owing to a mistake, it did not appear in print—though it is recorded in the rough minutes of this meeting—before the May number of the Academy's Proceedings. It was at that time supposed to be a new mineral from the difference of angle found by Prof. Dana between it and other homœomorphous sulphates, and from a qualitative analysis that I made, from which it was considered a double sulphate of potash (the potash I then thought was in excess) and ammonia, and anhydrous (in this judging erroneously from the form).

The composition is now definitely determined by a thorough quantitative examination, which, by the courtesy of Dr. F. A. Genth, I have made in his laboratory, whom I would here thank for the facilities afforded me in the investigation.

Lecontite occurs in crystals varying greatly in size, some being an inch in length and narrow prisms, others short, not exceeding one-sixteenth of an inch and quite broad. The former crystals are more perfect in form than the larger ones, and the angles better defined.

The following are the measurements of Prof. Dana: the crystals, as he mentions, did not admit of measurement by a reflected image, so that it was necessary to use a candle.

Crystallization trimetric; form right rhombic prism—

$i\text{-}\breve{2} : i\text{-}\breve{2} = 115°$

$i\text{-}\breve{2} : I = 160°$ by measurement.

$\frac{1}{4}\text{-}\bar{i} : \frac{1}{4}\text{-}\bar{i} = 127°\ 30'—128°$, or over $i\text{-}\bar{i}$, 52°—52° 30′

$I : I$ (calc. from $i\text{-}\breve{2} : i\text{-}\breve{2} =$ { 76° 48′ over $i\text{-}\breve{2}$, 103° 12′ over $i\text{-}\bar{i}$.

The faces I are small and indistinct except on one side.

Taking $\frac{1}{4}\text{-}\bar{i} : \frac{1}{4}\text{-}\bar{i} = 128°$ we have $I : I = 103°\ 12'$, $O : 1\text{-}\bar{i} = 117°\ 7'$.

In hardness the crystals are from 2 to 2·5; when free from the exterior organic matter they are clear and colorless; the smaller crystals are partially coated by a very thin crust of organic matter, from the matrix; taste, saline and rather bitter; permanent in the air. Composition:

Ammonia, per cent,	12·94	contains oxygen	3 98	}	8·93
Potassa, "	2·67	" "	0·45		
Soda, "	17·56	" "	4·50		
Sulphuric acid, per cent	44·97	" "	26·94		
Water, "	19·45	" "	17.28		
Organic residue, "	2·30				
Inorganic residue, "	0·11				
Phosphoric acid,	*a trace.*				

There is consequently an oxygen ratio of $NH_4O : SO_3 : HO = 8{\cdot}93 : 26{\cdot}94 : 17{\cdot}28$, which is almost exactly as 1 : 3 : 2 from which we have the general formula $RO, SO_3 + 2HO$.

[It may be interesting to mention that there is an artificial salt with a general formula, exactly corresponding to this $RO, SO_3 + 2HO$, and of the same form, which, though rare, has been described by several chemists: it contains no potash, being solely a double sulphate of ammonia and potash with two equivalents of water; it is mentioned in Gmelin, vol. iii, p. 119, (Card. Edit.,) Séguin, Ann. Chem. 91, 219; Reffault, Ann. de Chem. et Phys. 20 (432)—(435) describes the salt and its preparation. Berzelius (3,286) mentions that the crystals are derived from right rhombic prisms.]

This mineral was first brought to this country in January last by Dr. John L. LeConte, on his return from Honduras; he discovered it in the cave of Las Piedras, in the vicinity of Comayagua. It occurs in trimetric crystals, imbedded in a black matrix resembling bitumen in appearance, which Dr. LeConte considers to be the decomposed excrement of bats which infest this cave in great numbers, and have most likely inhabited it for ages; the cave near the entrance was, at the time of his visit, being worked for the nitre, which was obtained "directly by lixiviating the earth taken from near the mouth of the cave." "The matrix containing the crystals merely furnished a black tar-like semi-fluid mass without nitre." On some of the crystals were observed minute hairs of the bats adhering, and I observed more hair when removing the crystals from their matrix.

In honor of Dr. LeConte, who has been the means of adding this species to mineralogy, I propose to call the mineral **Lecontite.**

2. *Conducting Power of Rocks.—Altitude of Mountains not Invariable;* by Charles Maclaren, (Edin. N. Phil. Jour., vol. vii, p. 170).—Mr. Hopkins of Cambridge has made some rather interesting experiments on the *conductivity* or conducting power of different substances for heat, of which an account was laid before the Royal Society of London in June last. Without attempting to describe his processes, we give his more important results, and in decimals, the conductivity of "igneous rock" (trap or granite, we presume), saturated with moisture, being taken as unity.

Chalk, in the state of *dry powder*,	·056
Clay, " "	·07
Sand, " "	·15
Sand and clay, "	·11

The conductivity of the following rocks is given in two states—*dry*, and *saturated*, with water:—

	Dry.	Saturated.
Chalk, in block,	·17	·30
Oolite rock,	·30	·40
Hard compact limestones,	·50	·55
Siliceous New Red Sandstone,	·25	·60
Freestone,	·33	·45
Hard compact sandstones (Millstone Grit),	·51	·76
Hard compact old sedimentary,	·50	·61
Igneous rocks,	·53	1·00

The effect of *pressure* on the conducting power of substances was also tried, and proved to be almost nothing. A pressure of 7500 lb. on a square inch of beeswax, spermaceti, and chalk, had no appreciable effect. Uncompressed clay, which had a conducting power of ·26, had the same raised to ·33 by a pressure of 7500 lb.

Sandstone, with conducting power of ·5, divided into layers each 1 foot thick, when compared with a similar mass in one block, had its conducting power diminished $\frac{1}{20}$th. When the layers were only 6 inches thick the diminution was $\frac{1}{10}$th. The effect of discontinuity of substance is therefore small. Saturation with moisture, on the other hand, produces generally a great effect, as will be seen on comparing the dry and saturated blocks of chalk, the dry and saturated New Red Sandstone, and again the dry and saturated "igneous rocks."

These facts have a certain bearing on a geological question—namely, the transmission of heat from the interior of the earth to the crust. The oolite, for instance, conducts heat much better than the chalk, the sandstone better than the oolite, the igneous rock better than the sandstone, and in all cases the rock charged with moisture better than the dry rock. But Mr. Hopkins would have added to the value of his paper, if he had ascertained by experiment the quantity of water absorbed by each rock at given temperatures, and whether the conductivity is exactly in proportion to the absorption.

In illustration of the use that may be made of the tables, we would refer to certain remarks made by Dr. Robinson on a paper read by Professor Hennessy at the recent meeting of the British Association. The subject was "The Direction of Gravity at the Earth's Surface." In alluding to certain supposed local and temporary changes of level, he mentioned the following curious fact:—"He found *the entire mass of rock and hill on which the Armagh Observatory is erected, to be slightly, but to an astronomer quite perceptibly, tilted or canted at one season to the east, at another, to the west.* This he at first attributed to the varying power of the sun's radiation to heat and expand the rock throughout the year; but he subsequently had reason to attribute it rather to the infiltration of water to the parts where the clay-slate and limestone rocks met. The varying quantity of this (water) through the year he now believed exerted a powerful hydrostatic energy, by which the position of the rock is slightly varied." With the light furnished by Mr. Hopkins's experiments, we may pronounce the explanation satisfactory. Armagh and its observatory stand on a hill at the junction of the mountain limestone with the clay-slate, having, as it were, one leg on the former, and the other on the latter, and both rocks probably reach downwards one or two thousand feet. When rain falls, one will absorb more water than the other; both will gain an increase of conductive power, but the one which has absorbed most water will have the greatest increase; and being thus the better conductor, will *draw a greater portion of heat from the hot nucleus below to the surface*—will become in fact temporarily hotter, and, as a consequence, *expand more than the other.* In a word, *both rocks will expand at the wet season; but the best conductor, or most absorbent rock, will expand most, and seem to tilt the hill to one side; at the dry season it will subside most, and the hill will seem to be tilted in the opposite direction.*

The fact is curious, and not less so are the results deducible from it. *First*, hills are higher at one season than another, a fact we might have supposed, but never could have ascertained by measurement. *Secondly*, they are highest, not as we would have supposed at the hottest season, but at the wettest. *Thirdly*, it is from the *different rates* of expansion of different rocks that this has been discovered; had the limestone and clay-slate expanded equably, or had Armagh Observatory stood on a hill of homogeneous rock, it would have remained unknown. *Fourthly*, though the phenomenon is in the strictest sense *terrestrial*, it is by converse with the *heavens* that it has been made known to us. A variation of probably a second, or less, in the right ascension of three or four stars, observed at different seasons, no doubt revealed the fact to the sagacious astronomer of Armagh, and even enabled him to divine its cause; which has been confirmed as the true cause, and placed in a clearer light by the experiments of Mr. Hopkins. One useful lesson may be learned from the discovery—to be careful to erect Observatories on a homogeneous foundation.

3. *Explorations under the War Department:* Explanations of a second edition of a Geological Map of Nebraska and Kansas, based upon information obtained in an expedition to the Black Hills under the command of Lieut. G. K. Warren, Top. Engr., U. S. A.; by F. V. Hayden, M.D., Geologist to the Expedition.—The geological map accompanying this paper, is prepared chiefly from the author's own observations for several years past on the Missouri river and its tributaries. For the Permian in Kansas he is mostly indebted to the labors of Maj. Hawn. A much larger surface might have been colored on the map with a good degree of confidence, but the author has preferred to let it represent the actual state of our present knowledge of the geology of that region.

The rocks of Nebraska, as far as they are at present known, are referable to the following geological systems:

I. Metamorphosed azoic rocks, including granite.
II. Lower Silurian. (Potsdam Sandstone.)
III. Devonian?
IV. Carboniferous.
V. Permian.
VI. Jurassic.
VII. Cretaceous, Upper, Middle and Lower (including Wealden?).
VIII. Tertiary.
IX. Post-pliocene or Quaternary.

The main body of the Black Hills and the Laramie range of mountains is composed of a coarse red feldspathic granite as a nucleus, surrounded by a series of Azoic stratified rocks standing vertical or nearly so, with occasional dikes or outbursts of basaltic and other trappean rocks.

The existence of the Potsdam sandstone on the eastern slope of the Rocky Mountains was discovered during Lieut. Warren's expedition to the Black Hills in the summer of 1857, and first made known by Messrs. Meek and Hayden in a paper published in the Proceedings of the Academy of Natural Sciences at Philadelphia, March, 1858. The Black Hills seem to have furnished the key to its existence in the far west,

where it is found to contain quite numerous well preserved fossils, as Lingula (L. antiqua), Trilobites, &c., similar or identical with those characterizing the same formation in Minnesota and New York. Its geographical distribution in the far west then becomes an interesting question, and the following suggestions from the paper, may call attention to that point.

"Inasmuch as we have no palæontological evidence of the existence of this formation in the Rocky Mountain range, we must depend upon the somewhat uncertain data of lithological resemblance and position, for its geographical distribution. Prof. Hall, in Stansbury's Report, often describes a bed of sandstone corresponding in its lithological characters and geological position to the Potsdam sandstone in the Black Hills. Stansbury's Island (Great Salt Lake), the summit of which is three thousand feet in height, is capped with Carboniferous limestone, which also rests upon a coarse sandstone and conglomerate. Again, north of Great Salt Lake City, the "limestone overlies a coarse sandstone or conglomerate, which almost invariably accompanies it." "In several localities, as at Promontory Point, and near Mud Island, the metamorphic strata appear to be overlaid by a coarse conglomerate or coarse sandstone, which is partially altered and assumes the character of a quartz rock." Marcou, in the third volume of Pacific R. R. Reports, page 156, speaks of a sandstone occurring near the Aztec Mountains. He says: "We traveled seven miles upon the granite, and on our right we found a cliff twelve hundred feet high. From the base to the middle we found the granite, then a band of red sandstone, (Devonian or Old Red). Above this, the beds of limestone and gray sandstone, belonging to the mountain limestone." The following day "we traveled three miles on the granite, the remainder on the Old Red Sandstone."

The diagram given, showing the order of superposition of the different rocks, would apply equally well to the similar beds in the Black Hills. Many other less evident indications along the base of the Rocky Mountains might be cited from published reports, but what has been said will be sufficient to show what we may hereafter expect with regard to its geographical distribution in the far west."

The Carboniferous rocks, so well developed at Fort Laramie, in the Black Hills, and many other localities along the eastern slope of the Rocky Mountains, have been referred by some authors to the age of the Lower Carboniferous or Mountain Limestone.

Mr. Meek was at first in some doubt in regard to which division of the Carboniferous system the fossils, which were in a bad state of preservation, belong. But after a further examination, and since he has seen in a late publication by Mr. Marcou in what association they occur in the southwest, has little hesitation in referring these rocks in the Black Hills to the upper instead of the lower Carboniferous series. The author observes:

"The Black Hills have, up to this time, afforded the most satisfactory evidence of the existence of this system in the West. It is there brought to the surface by the upheaval of the older rocks in the form of a belt or zone, five to fifteen miles in width, engirdling the principal axis of elevation. None of the organic remains already discovered, which are quite

numerous in species, are known to be positively identical with those found in the same system in the old world, but they belong to the same genera, and many of the species are so closely allied to forms characteristic of the Jura of Europe, that we cannot now hesitate to admit this system into our series. I will here repeat the palæontological evidence, which was read before the Academy in March last by Mr. Meek and myself, with such additional proof as we have been able to secure by our investigation of the undescribed fossils in the collection, up to the present time.

1st, *Pentacrinus asteriscus*, n. sp., is so nearly like the Liassic *P. scalaris*, Goldfuss, that it is with some hesitation we have regarded it as new.

2d, *Avicula* (*Monotis*) *tenuicosta*, n. sp., is very closely related to *M. substriata*, of Munster, from the Lias.

3d, *Arca* (*Cucullæa*) *inornata*, n. sp., is very similar to *C. Munsteri*, (Zeiten,) also from the Lias.

4th, *Panopæa* (*Myacites*) *subelliptica*, n. sp., is similar to the Liassic forms *M. Liasensis* and *M. Alduininus*, of Quensted.

5th, *Ammonites cordiformis*, n. sp., is of the same type as the Oolitic species *A. cordatus* (Sowerby).

6th, *Belemnites densus*, n. sp., is scarcely distinguishable from the Oolitic species *B. eccentricus*, Blainville, if, indeed, it is really distinct.

We have, also, in the collection from the Black Hills, a species of Hettangia, a genus not known to occur in the old world in formations newer than the Lias, and a Trigonia more nearly resembling Jurassic types than those of any other formation.

Although it is not yet known to occupy a large geographical area in this country, we have indications that it will be found extensively developed on the eastern slope of the Rocky Mountains, from the northern part of British America to New Mexico. That it exists toward the head waters of the Yellow Stone, around Panther and Big Horn Mountains, I cannot doubt.

In the summer of 1854, while exploring the valley of the Yellowstone, as far as the mouth of the Big Horn River, I received, from intelligent traders, masses of gypsum precisely like that characterizing the Jurassic beds in the Black Hills."

The paper closes with some remarks on the Tertiary basins of the upper Missouri. A complete "vertical section showing the order of superposition of the different beds of the Tertiary basin of White and Niobrara Rivers" is given, also a catalogue of all the organic remains hitherto described with a table showing their stratigraphical position. The number of Vertebrata given in this catalogue are sixty-three, of Mollusca five, and one Crustacean.

4. *Gold in Georgia.—Report upon the Gold Placers of a part of Lumpkin county, Georgia, and the practicability of working them by the Hydraulic Method;* by Wm. P. Blake, late Geologist and Mineralogist of the Pacific Railroad Survey in California. J. F. Trow, New York, 1858, small 4to, pp. 39, with a map.—This is a well digested statement of a subject of great commercial importance to the whole region where gold-bearing detritus is found on the Atlantic slopes of the Appalachians. Mr. Blake's familiarity with the hydraulic method as practiced in California, and which he has so clearly described in his official Report on the

Railway Survey, has fitted him in an uncommon degree to be the adviser of those who contemplate similar enterprises in the eastern gold region of the United States. He finds by exploration that gold is very generally (almost uniformly) distributed in the soil and drift on the hills, hillsides, and in the valleys and dry ravines of Lumpkin county, Ga., as in other gold regions. Water from the Chestatee river may be had in abundance, and at an elevation sufficient to wash by the use of hose all the deposits, with a probable yield of from five to twenty dollars a day for each pipe employed, with a probability of greater results. The results of assays at Dahlonega Branch Mint for twenty years show an average richness of 928 thousanths for the gold of that region. The total product to the close of 1855, nearly six and a half millions of dollars, ($6,488,932).

5. *The Tertiary Climate.*—Professor Unger of Vienna has found genuine reef-forming Corallidæ in the Tertiary strata of the Pannonian basin (southeast from Vienna) in latitude 47°, while at present the northern limit of such corals in the Red Sea and Persian Gulf is at 29°, thus furnishing a new proof of the higher temperature which prevailed in Europe at the Tertiary period.—(*Edinb. New Phil. Jour.*)

III. BOTANY AND ZOOLOGY.

1. *Obituary of Robert Brown.*—"This distinguished botanist died on Saturday last, [June 12,] at his house in Dean street, Soho, in the eighty-fifth year of his age. Though less popularly known as a man of science than many of his contemporaries, those whose studies have enabled them to appreciate the labors of Brown rank him altogether as the foremost scientific man of this century. He takes this position not so much from his extensive observations on the structure and habits of plants, as from the philosophical insight he possessed, and the power he displayed of applying the well-ascertained facts of one case to the explanation of doubtful phenomena in a large series. Till his time botany can scarcely be said to have had a scientific foundation. It consisted of a large number of ill-observed and badly-arranged facts. By the use of the microscope, and the conviction of the necessity of studying the history of the development of the plant in order to ascertain its true structure and relations, Brown changed the face of botany. He gave life and significance to that which had been dull and purposeless. His influence was felt in every direction—the microscope became a necessary instrument in the hands of the philosophical botanist, and the history of development was the basis on which all improvement in classification was carried on. This influence extended from the vegetable to the animal kingdoms. The researches of Schleiden on the vegetable cell, prompted by the observations of Brown, led to those of Schwann on the animal cell; and we may directly trace the present position of animal physiology to the wonderful influence that the researches of Brown have exerted upon the investigation of the laws of organization. Even in zoology the influence of Brown's researches may be traced in the interest attached to the history of development in all its recent systems of classification. Brown had, in fact, in the beginning of the present century, grasped the great ideas of growth and development, which are now the beacon lights of all research in biological science, whether in the plant or animal world.

"But whilst his influence was thus great, his works are not calculated to attract popular attention. They are contained in the transactions of our learned Societies, in the scientific appendices of quarto volumes of voyages and travels, or in Latin descriptions of the orders, genera, and species of plants. The interest taken in these works by his countrymen was never sufficient to secure for them republication, although a collected edition of his works, in five volumes, is well known in Germany. He was of a diffident and retiring disposition, shunning whatever partook of display, and anxious to avoid public observation. Thus it is that one of our greatest philosophers has passed away without notice, and many will have heard his name for the first time with the announcement of his decease. But for him an undying reputation remains, which must increase as long as the great science of life is studied and understood.

"Robert Brown was the son of a Scottish Episcopalian clergyman, and was born at Montrose on the 21st of December, 1773. He was first entered a student at Marischal College, Aberdeen, and afterwards studied medicine at Edinburgh, where he completed his studies in 1793. In the same year has was appointed assistant-surgeon and subaltern in a Scotch Fencible Regiment, which he accompanied to Ireland, and stayed there till the end of 1800. Having through his love of botany made the acquaintance of Sir Joseph Banks, he was through his interest appointed naturalist to Capt. Flinders's Surveying Expedition to New Holland. During this voyage the whole continent of Australia was circumnavigated, many parts of the coast were visited, and eventually the ship in which in the Expedition sailed was condemned as unseaworthy at Port Jackson in 1803. Mr. Brown remained in New Holland, visiting different parts of the colony of New South Wales and Van Diemen's Land, and eventually returned to England in 1805. Australia was then an unexplored mine of botanical wealth. Brown returned with nearly 4,000 species of plants. He was shortly after appointed Librarian to the Linnean Society. Here he quietly examined his plants, and evolved with philosophic caution and patience those views which were destined to produce so extensive and lasting an impression on science. One of his earliest papers was published in the Transactions of the Wernerian Society of Edinburgh, and was devoted to the family of plants called by him 'Asclepiadæ.' In this paper the character of mind of the author is well seen. The microscope had been used, the process of development had been watched, a new series of facts important to the laws of reproduction had been discovered, and a new order of plants established. Such was the nature of most of his future communications to the Linnean and Royal Societies. Such was the character of his great work on the plants of New Holland, which he published in the year 1810, with the title 'Prodromus Floræ Novæ Hollandiæ et Insulæ Van Diemen.' This work contained not only a description of the plants which he had himself collected in Australia, but also those collected by Sir Joseph Banks during Cook's first voyage. This book abounded in new facts and new orders. It was published as a first volume, but it was never succeeded by a second, as appeared to have been originally intended by the author. At the time this work was published, it was the practice of English botanists to arrange plants according to the artificial method of Linnæus, and Brown's 'Prodromus' was

the first English work devoted to a scientific and rational classification of plants. Although the Linnean system of classification survived some time after the publication of this work, it eventually succumbed before those principles of arrangement which were carried out in so masterly a manner by Brown, and the importance of which had been recognized by John Ray and Adanson, and even by Linnæus himself.

"In 1814 Capt. Flinders published a narrative of his voyage, and to this was attached an appendix by Brown, entitled 'General Remarks, Geographical and Systematical, on the Botany of Terra Australis.' In subsequent years several important papers appeared in the *Transactions of the Linnean Society*. Amongst others may be named, 'On the Natural Order of Plants called Proteacæ,'—'Observations on the Natural Family of Plants called Compositæ' (vol. xii),—'An account of a New Genus of Plants called Rafflesia' (vol. xiii). In 1828 he published in a separate form 'A Brief Account of Microscopical Observations on the Particles contained in the Pollen of Plants, and on the general existence of active Molecules in Organic and Inorganic Bodies.' These movements, the full import of which is at present not understood, he was the first to point out, and draw attention to their importance. On the Continent it is the custom to allude to this phenomenon as the 'Brunonian movement.' He is the author also of the botanical appendices attached to the accounts of the voyages of Ross and Parry to the Arctic Regions, of Tuckey's expedition to the Congo, and of Oudney, Denham, and Clapperton's explorations in Central Africa. Assisted by Mr. Bennett, he has also described the rarer plants collected by Dr. Horsfield during his residence in Java.

"After the death of Dryander in 1810, Dr. Brown received the charge of the library and collections of Sir Joseph Banks, who bequeathed them to him for life. They were afterwards, by his permission, transferred to the British Museum in 1827, and he was appointed Keeper of Botany in that Institution. In 1811 he became a Fellow of the Royal Society, and has several times been elected on the Council of that body. In 1832 he received the degree of D.C.L. from the University of Oxford. In 1833 he was elected one of the eight Foreign Associates of the French Academy of Science. In 1839 the Royal Society awarded him their Copley medal for his discoveries during a series of years 'On the subject of Vegetable impregnation.' In 1849 he was elected President of the Linnean Society, a post from which he retired in 1853. During the administration of Sir Robert Peel he received a pension of 200*l.*, as a recognition of his scientific merits. He also received the decoration of the highest Prussian civil order, 'Pour le Mérite,' of which his friend and survivor at the age of eighty-eight, the Baron von Humboldt, is Chancellor. Humboldt long since called him 'Botanicorum facile Princeps,' a title to which all scientific botanists readily admitted his undisputed claim.

"He died surrounded by his collections in the room which had formerly been the library of Sir Joseph Banks. In private, Dr. Brown was greatly admired by a large circle of attached friends for the singular soundness of his judgment, the simplicity of his habits, and the kindness of his disposition. He was buried on the 15th inst. at the cemetery at Kensal Green, when his funeral was attended by a large body of his scientific and personal friends."—*The* [*London*] *Athenæum*, *June*, 1858.

The obituary notice, here transferred to our pages, was written and published a few days after the decease of the great botanist of our age. We know not whether we may in time expect, from the same competent hand a fuller account of Mr. Brown's labors and writings, and a critical estimate of the influence they have exerted upon the progress of scientific botany in the nineteenth century. Such an exposition should be attempted, both as a fitting tribute to great master's memory, and because few even of the cultivators of science, besides the leading botanists of the day, are well aware of the nature and extent of this influence. It has reached the generality even of botanists only by indirect channels, after permeating—all too slowly and imperfectly—the minds of the principal systematic writers and teachers of the last half century. While every student of general botany daily uses the works of DeCandolle, and has some tolerably clear idea of his indebtedness to Linnæus and to Jussieu; while these and some inferior names are familiar to most educated persons, how few even of his own countrymen knew anything of a botanist, surviving to the present year, who was second only to the most illustrious of these in the extent and depth of his knowledge, and second to none in sagacity. This has been owing, "partly to the length of time that has elapsed since his great discoveries were made; partly to the quiet and unostentatious manner in which they were announced; partly to the brevity of his style, and the comparatively small bulk of his published works, and most of all to his singularly retiring and unobtrusive disposition;"* and partly, we would add, to some characteristic peculiarities in his mode of communicating his results, which none of these specifications, nor all of them, fully describe. How thoroughly he has been appreciated, however, in his life time, in the ranks of pure science is evident from the deference with which his name is pronounced by the *savans* of every country, by the title with which Humboldt long ago saluted him, and by the fact "that his name stands at the head of the list of honorary fellows of more scientific academies than that of any other individual, not even excepting Humboldt."* How profoundly he has been admired and venerated by those who enjoyed the enviable advantage of his acquaintance and his friendship, this is not the place to say.

Whoever undertakes to present a summary of his investigations and a just estimate of their importance, will have to write the history of botany, in all its departments, for the last fifty years, and to point out,—perhaps in some sententious note, in a short paper whose title made no proclamation of the high questions it incidentally discussed,—the germ, if not the succinct development, of each discovery or philosophical deduction which has stood the test of time and helped to make modern botany what it is; and will commend his style as a model of compactness and precision. Whoever portrays the lineaments of so marked a character as that of Brown will exhibit, among its distinctive features, his unrivalled sagacity, his lively and pervading sense of justice, his perfect impartiality and truthfulness, his profoundly conscientious accuracy; and also his extreme caution, and an excessive retinence in strong contrast with the desire of most discoverers to communicate their knowledge to the world. Perhaps no naturalist has ever taught so much in writing so

* Gardener's Chronicle, June 19.

little, or made so few statements that need to be corrected or even modified; and in respect to none can there be a stronger regret that he did not publish more. A. G.

2. *Journal of the Proceedings of the Linnæan Society*, No. 8, concluding Vol. II, was promptly issued in May. The botanical portion contains,

Botanical Report on the North Australian Expedition under the command of A. C. Gregory, Esq.; by Dr. Ferdinand Müller, Botanist of the Expedition. This is concluded from the last number; it ends with some tables showing the range northward of extratropical Australian species; and with an index of the genera observed, with an approximate determination of the number of species of each collected.

Præcursores ad Floram Indicam; by Drs. Hooker and Thomson.—In the present number the *Caprifoliaceæ* are elaborated. The genera of *Lonicereæ* are *Loniceria*, *Leycesteria* (hardly distinct from the former genus), *Triosteum* (a North American species with one Himalayan species), *Abelia* (a Chinese and Japanese type), and *Dichilanthe* of Thwaites, from Ceylon. Of the *Sambuceæ*, there are the two genera, *Viburnum* and *Sambucus*. A preliminary note explains the structure of the ovule in the order; it is a nucleus with the integuments nearly undeveloped. "Besides the many well-known points of close affinity between *Caprifoliaceæ* and *Rubiaceæ*, an examination of the Indian plants of the former order enables us to add one which has generally been supposed to present a good distinguishing character between them, namely, the large stipules present in two genuine specimens of *Lonicera* itself." We add that such stipules are evident in several species of *Viburnum*.

Extract of a letter from Mr. George Barter; the botanist of the new expedition now exploring the Niger or Quorra.

On the question whether Linnæus, in a spirit of ill-will, altered the spelling of the name of the genus Buffonia; by Prof. Fée, of Strasburg.

Note on the preceding communication; by John J. Bennett, the Secretary of the Linnæan Society, giving the result of an examination of the letters addressed by Sauvages (the real founder of the genus) to Linnæus. The result arrived at is that the charge is unfounded. Because the name, mis-spelt *Bufonia*, was published by Linnæus in the year 1747; "and it was not until 1749 that the offence, which it has been supposed to be intended to avenge, was given to Linnæus and all other 'methodists,' in the preface to Buffon's great work, commenced in that year." The converse question is not raised whether the misspelling of the name, however it happened, may not have been an exciting cause of Buffon's attack. A good index of species is appended to the volume. A. G.

3. *Flora of Australia.*—The British Government having made a handsome appropriation for the preparation of a general Flora of Australia, it is understood that Mr. Bentham will undertake this formidable work. It could not fall into more competent hands. Now that the government of India is vested in the crown, and the enlightened statesman who, when Colonial Secretary, procured this appropriation to be made is likely to be placed at the head of the Indian government, we shall confidently expect to hear of a similar grant, by which aid alone can one of the most important works of the age, viz. *Flora Indica* of Drs. Hooker and Thomson, be continued and completed. A. G.

4. *Life Beneath the Waters, or, The Aquarium in America;* by A. M. EDWARDS, member of the N. Y. Lyceum of Natural History. New York, H. Bailliere, 1858.—Notwithstanding the great interest which has been felt in this country for the last two years in the beautiful water-gardens which form the subject of this book, the public have as yet been entirely dependent for a knowledge of their construction and management upon the various English works relating to them, which have appeared in rapid succession since the year 1850, when they were first invented in that country. The natural history in these works answers admirably for students on the transatlantic shores, but is of little use in our country, where the aquatic animals, both fresh-water and marine, are mostly very different from those of Europe.

The announcement of the title of the work, "The Aquarium in *America*," was hailed with pleasure by the many lovers of nature on this side of the Atlantic,—notwithstanding the implied assertion that it was newly introduced here, while in fact, these self supporting aqua-vivaria were used here before their invention in Europe. Still nothing had been published in regard to the subject; and the want of a work which would inform those interested how to establish and stock their tanks, and to learn the names and characteristics of the animals and plants placed in them, was felt by all. This want, however, the work before us fails to supply. Notwithstanding its patriotic title, it is still a *British* book, consisting in great part of ill selected matter from Gosse, Humphrey, Hibberd, and other British authors. Were this openly avowed, no harm would be done, for the reader would then understand that the zoology of the work applied mostly to Great Britain; but as it is, unless well versed in the science, he is led to suppose that a large number of the species belonging to that country are commonly found on our shores, while in fact they do not exist here at all. On page 23, for instance, our author in describing the contents of his tank, mentions *Actinia mesembryanthemum*, *A. fragacea*, *A. tigrina*, and *A. gemmacea;* but omits to mention that these are all British species. It is somewhat surprising that Mr. Edwards should have had to import Actiniæ from Europe, when we have so many equally beautiful species living among our own rocks and islands; but this, as well as the whole tenor of the work, abundantly shows that the author has but a very slight and imperfect acquaintance with our marine zoology. The list of sea animals is very meagre; thus out of some 600 species known to inhabit our shores, only about thirty or forty are mentioned, and these by no means the most beautiful and interesting, nor the best adapted for an existence imprisoned in the aquarium.

Among the animals attributed to America, but which do not really exist here, the following may be mentioned: The *Triton* figured on plate 6 is a British species. On page 77 *Lymnæa fragilis* is said to be an inhabitant of New York; it is also British. Neither of the *Scorpænæ* mentioned on page 116 are found on our coast; nor is the *Fistularia tabacaria*, incorrectly classed with the "hideous pipe-fishes" *Syngnathus*, which latter are among the most beautiful and long lived fishes that can be placed in an aquarium. On page 117, our common fresh water sucker "*Catostomus communis*" is said to be a marine fish! Our malacologists will be surprised to learn, on page 77, that the genus *Physa* is represented in New

York by eleven species! Among other remarkable statements we notice the following. On page 133, a zoophyte is said to consist like a "human creature," of "flesh, blood, and bone." The means by which certain zoophagous mollusks perforate the shells of bivalves is said to be "yet unknown." The story told on page 143, of the terrible Actinia some feet in diameter by which an officer of the British navy was seized, would apply with greater probability to a large *Octopus*.

These few examples are enough to enable the reader to determine how much reliance is to be placed upon the scientific accuracy of the publication before us. Yet on page 46 the author very ingeniously suggests to the collector who has returned home laden with the spoils of the river-bank or sea-beach, to "take this or any other book that treats of the subject, and see if you can find out the names of your plants and animals." We advise the reader by all means to try the 'other book.'

The work abounds in typographical (?) errors and misspelt scientific names and terms. We write *typographical* with a query, being in doubt whether errors occurring simultaneously in the plates and text can properly be charged to the printer. Yet the list of Errata contains only three or four attempts at correction, which are not always successful, as "for *T. tabbacaria* read *F. tabbacaria*," and "for *cyprynis* read *cyprynus*." And such terms as "tentaculae," "Crustaceae," "planorbi," etc., which are constantly recurring, certainly do not speak well for the erudition of the author.

The *plates* are remarkable neither for accuracy nor artistic excellence. The figures of marine animals, with the exception of those copied without acknowledgment from British works, are mere caricatures of the original. In some of the Crustacea, for instance, opposite feet are represented as differing in the number of joints.

The work, nevertheless, contains many novel and valuable suggestions concerning the management of the aquarium, about which the author's experience as a dealer enables him to give much reliable information.

W. S.

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *The Atlantic Cable.*—While all hoped earnestly for the successful issue of the last telegraphic expedition which left Queenstown, England, July 17, for mid ocean, we believe there were few whose fears of a third failure were not greater than their hopes of success. When, therefore, about noon of August 5th, the news of the safe arrival of the Niagara and Gorgon at Trinity Bay, with the cable unbroken, was flashed over the length and breadth of the land, there was at first, almost universal skepticism as to the authenticity of the news. This gave way, however, in a few hours before the accumulating evidence, and a wild gush of joy broke out from every quarter, such as no event in modern history has ever occasioned.

The great fact that the cable is laid without accident, and that its insulation and transmitting power are reported perfect, render the question of plateau or no plateau, discussed on pp. 157 and 219 of this volume of secondary importance to the public; and yet as a geographical and geological problem, it is still one of great interest. We may be permit-

ted to say that while we believe, on what seem to us ample geological grounds, in the pretty uniform and rather moderate depth of that portion of the Atlantic where the cable now rests, it has never appeared to be a point of much practical moment whether the depth of water in which the cable was to be laid was 1000, 2000, or 3000 fathoms. In any case it was very sure to find bottom and rest there; and the distance across is no greater at the greater depth. The discussions of Professor Trowbridge afford valuable suggestions with regard to all deep sea soundings, and we trust that his method when perfected may be the means of giving us reliable results respecting the whole ocean.

In the absence of any official documents, we quote from the daily journals some facts relating to this great event, drawn from the private journal of CYRUS W. FIELD, Esq., to whose dauntless energy, skill, and hearty faith in a successful issue, the world will ever be eager to award the highest praise, since to him more than to any other person belongs, beyond doubt, the credit of conceiving and carrying through this great enterprise.

Saturday, July 17, 1858. The telegraphic fleet sailed from Queenstown, Ireland, as follows: the Valorous and Gorgon at 11 A. M.; the Niagara at 7½ P. M., and the Agamemnon a few hours later. All the steamers were to use as little coal as possible in getting to the place of rendezvous.

Friday, July 23. The Niagara arrived at the rendezvous, latitude 52° 5′, longitude 32° 40′ at 8.30 P. M., the Valorous followed at 4 A. M. of July 25, the Gorgon at 5 P. M. July 27, and the Agamemnon at 5 P. M. of July 28. The weather had been cloudy and squally until the 21st, but appears on the whole not to have been unfavorable.

Thursday, July 29. Latitude 52° 59′, longitude 32° 27′ W., the telegraphic fleet all in sight, with a smooth sea, cloudy sky, and a light wind from the S.E. to S. At 1 P. M. of this day the "splice" was successfully made between the two ends of the cable, and electrical signals passed perfectly through the whole length on board both ships. Depth of water 1550 fathoms. The distance from the entrance of Valentia harbor was eight hundred and thirteen nautical miles; to the entrance of Trinity Bay, N. F., eighteen hundred and twenty-two nautical miles, and from there sixty miles to the telegraph house at the head of the Bay of Bulls, equal in all to eight hundred and eighty-two nautical miles. The Niagara had sixty-nine miles farther to run than the Agamemnon. Each ship had on board about eleven hundred nautical miles of cable. The following table presents a condensed view of the Niagara's voyage:

Date.	Lat. N.	Long. W.	Dist. sailed in last 24 hours.	Miles and fathoms of cable paid out.	Excess per cent.	Depth of water in fathoms.
July 30, Friday,	51° 50′	34° 49′	89	131*m.*	48	1550—1985
" 31, Saturday,	51° 50′	38° 28′	137	159*m.* 853*f.*	13	
Aug. 1, Sunday,	50° 32′	41° 55′	145	164*m.* 683*f.*	14	1950—2424
" 2, Monday,	49° 52′	45° 37′	154	177*m.* 150*f.*	15	1600—2385
" 3, Tuesday,	49° 17′	49° 23′	147	161*m.* 763*f.*	10	1742(?)—1827
" 4, Wedn'y,	48° 17′	52° 43′	146	154*m.* 360*f.*	6	200
" 5, Thursday, Niagara anchored.			64	66*m.* 382*f.*	4	

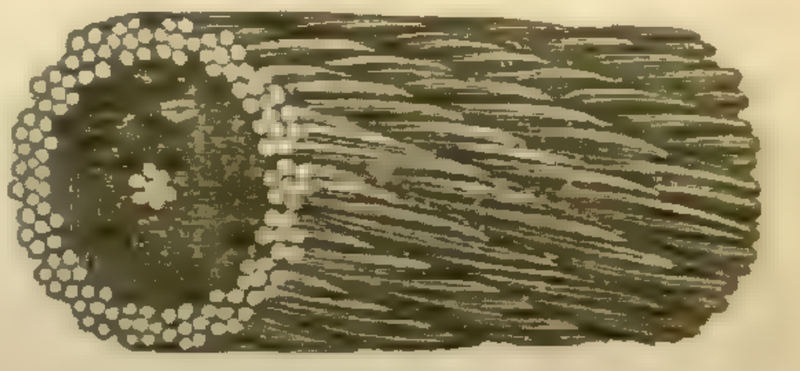
It will be observed that the distances run during the five full days were remarkably uniform, 149 miles per day, and the excess of cable paid out was about 15 per cent more than the ship's record. Twice during the

progress of the ship, from some unexplained cause, signals failed to pass between them, viz: at 7½ P. M. July 29, for an hour, and August 2, from 12h 38m A. M. to 5.40 A. M. But during all the remainder of the time signals were constantly received; and at the last, the Agamemnon, August 5, 2.45 A. M., signalized the Niagara that they had paid out 1010 miles of cable. The cable was landed at Valentia Bay on Thursday morning, August 5, at 5h 15m; and at 6 A. M. the shore end was carried into the telegraph house, and a strong current of electricity received through the whole cable from the other side of the Atlantic.

On the 17th of August the Queen of Great Britain sent a congratulatory message to the President of the United States, expressing in courtly terms her joy in the completion of this great international bond, to which President Buchanan responded in the same spirit. It has been suggested elsewhere that the Boston fire-bells, which are now rung by electricity, should be placed in communication with London and rung by the current from the company's office there.*

In the absence of any accurate scientific report of the details of the electrical arrangements, we are able at present to state only a few facts, most of which are probably already familiar to our readers.

The cable is only about six-tenths of an inch in diameter outside of the encasing wires. The figure annexed is a correct view of the exterior form and cross section of the cable. The electrical conductor is formed of seven No. 22 copper wires, the centre wire being straight, while its six surrounding wires form a spiral about it. The insulation is of refined gutta percha, laid on by machinery in three distinct coatings the more perfectly to insure insulation. Finally, seventeen strands of iron wire, No. 20, composed each of seven separate wires, laid up like the electrical conductor, encase the whole into a strong but very flexible rope, as easily handled as a rope of hemp. All the mechanical work and materials used in the preparation of the cable have been of the best description. The whole length of separate wires in this cable amounts to 332,500 miles, or about fourteen times the earth's circumference. The weight of the cable is almost exactly one ton (2000 lbs.) to the mile, and it bears a direct minimum strain of four tons, and much more has been put on it without fracture.



The magneto-electrical current designed to be employed is derived from a powerful combination of inducing coils and soft iron magnets. The cable is regarded as a Leyden jar inductively charged. and Mr. Whitehouse, the electrician of the company, states that by alternating impulses of positive and negative electricity, transmitted in rapid succession to the copper conductor, the evil effects of the reflex induced current in the iron wire cover is entirely overcome. We look with much interest for the memoir, which we suppose of course will be published by the company, giving the physical details, and the constants established by this elaborate research. It will also be very interesting to see on record an official description of the manufacture and paying out of the cable, with full plates, and a statement of the chief causes of delay and embarrassment, and their cure. But the

* Boston Transcript, August 13, 1858.

portion most interesting to science will be the electrical history of this great enterprise, the details of which have hitherto been only partially revealed, and that not in a scientific form. The only official account of the undertaking which we have seen is a pamphlet issued in July, 1857, by the company in London, entitled "The Atlantic Telegraph, a history of preliminary experimental proceedings, and a descriptive account of the present state and prospects of the undertaking." This pamphlet contains some novel and very interesting statements, but they are wanting in that accuracy and fullness of detail indispensable to a scientific statement, and the results are generally given only in rather vague terms.

2. *Notes of a visit to the "Mud Volcanoes" in the Colorado Desert, in the month of July*, 1857; by JOHN A. VEATCH, M.D., (Proc. California Acad. Nat. Sci., p. 104, 1857).—Among the numerous objects in California inviting the investigation of the scientific and the attention of the curious observer, none are more conspicuous than the "Salses" or "Mud Volcanoes" of the Colorado Desert. Hidden amidst the burning sands of a frightful waste, few persons have had the temerity to encounter the labor and risk of visiting them. Even the Indians, inhabiting the border of this Western Sahara, do not willingly venture so far into its midst, unless it be during the annual rains. At any other period, to miss one of the few springs of brackish water, or to find the place occupied by drifting sands—a not unusual occurrence—would entail the certainty of the horrors of thirst, if not loss of life. From personal experience I cannot blame the repugnance of the natives to visit a district, which, in addition to its physical repulsiveness, they suppose to be the abode of dark and malignant spirits.

The striking peculiarities of this wild region are, however, too striking to remain long unsubjected to thorough exploration. The entire desert is supposed to have been the bed of a great brackish or fresh-water lake, and is said to lay many feet below the level of the ocean. The part I lately visited showed deep lacustrine deposits, inclosing, in myriads, the conchological records of the former sea.

It was the month of July of the present year that I had occasion, in the progress of a mineralogical excursion to visit one of the above named salses. It is situated about one hundred and fifty miles from San Diego, and sixty miles in a north-easterly direction from the Indian village of San Felipe—the nearest inhabited habitable place. The exact locality, as reported by the U. S. Surveyors, is Township 11 South; range 13 East, San Bernardino meridian. The distance from San Felipe is as above given in an air line; but by any practicable route it is, at least, thirty miles farther, owing to the necessity of making a turn to the south, to find the only water on the route.

At the above named village, at the trading post of Messrs. Smith and Brill, we—myself and son—made preparation for our desert excursion, by procuring fresh horses and a guide, and obtaining provisions, and gourds and leathern bottles for carrying water. Our guide, José Serano, who was one of the Captains of his village, spoke Spanish, and was the only one of his people who had ever been actually at the spot we wished to visit. The weather was intensely hot, and the guide advised starting late in the afternoon, so as to have the advantage of a night's journey, and

thereby reach the watering-place early the next day,—before the heat became oppressive. The following I extract from my notes:

"Left San Felipe at 4 o'clock, P. M., July 17. Crossed the sharp Porphyritic mountain ridge separating San Felipe valley from the desert. San Felipe Creek cuts through the ridge here and runs off in a narrow cañon towards the desert. It is a bold, running stream, but never emerges from the cañon in summer, being literally drank up by the first breath of the thirsty desert wind. The bed of the stream is not practicable for horses, so we climbed the mountain, along an Indian pathway, and from the crest—about 1000 feet above the valley—had an extensive view of the desert, shading away into gloomy indistinctness and blending with the dull clouds that skirted the horizon toward the east. To the right and left, as far as the eye could reach, the mountain chain presented a series of fantastic and rugged serratures well in keeping with the sombre area of barren desolation it hedged in. A few stunted mesquit trees, a dwarf magey and a pretty fair representation of the Cacteæ, constituted the flora of the mountain. Descending the eastern slope at a rather sharp grade, we re-entered the San Felipe cañon. We received now and again puffs of hot wind, giving us a foretaste of the furnace-temperature of the broad, herbless plain below. The cañon sloped off rapidly, but with great regularity, expanding into a valley two or three miles wide and finally losing itself in the desert ten miles beyond. The soil—if the term be applicable—consisted of detrital matter and debris of the mountain rocks. A species of Catalpa, with slender, pendulous pods, grew in depressions marking the beds of winter torrents, and clusters of a tall shrub covered with strong sharp prickles from the root to the extremities of the branches, gave warning not to approach them too closely. Succulent and arborescent Opuntias occurred in clumps and patches; and the Echinocactus, with its rigid fish-hook spines, lay often half covered in sand, and our horses frequently started suddenly to one side to avoid them. The columnar form of a huge Cereus crowning some rocky eminences presented, often, a peculiar and picturesque appearance. Night overtook us in the valley, and our progress was much impeded by the Opuntias constantly pricking the horses, rendering them restless and fretful. The road grew worse and worse every mile, and about 11 o'clock a dense forest of bristling vegetation completely blocked the way. In attempting to force the barrier, my horse became furious and commenced plunging, and I had to choose between throwing myself off into the spring moss or suffer the horse to do it for me. I chose the first, and in attempting to hold the infuriated animal, was dragged and shoved alternately amongst Opuntias higher than my head, until my clothes were literally pinned to the flesh from head to foot by the barbed needle-like prickles. The horse fared no better, but I felt no great consolation on that score. José, with his *reata* came timely to the rescue, and the horse was secured just as the bridle reins broke in my hand and I came near experiencing the additional unpleasant mishap of being left horseless. Farther progress for the night was out of the question. The horse had freed himself from the saddle and riding gear, and was so covered with spines rankling in his skin, that to replace them was impossible; and even could the horse have borne the saddle the rider could not have borne the seat. So tying up in the most favorable spot that offered, a

light was struck and the residue of the night spent in extracting prickles from the flesh of man and horse.

"*July* 18.—At early dawn started again and had the good fortune to thread our way through the horrid grove without further mishap. A smooth surface of baked clay, in which not even a Cactus could root itself, gave place to the disintegrated mountain deposit, over which we passed at a sweeping trot. A beautiful specimen of selenite was picked up here, and water worn pebbles occasionally occurred. Two hours' ride brought us on to an enormous clay deposit, with fragments of thin bivalve shells—probably the margin of the ancient lake. The soil became gradually more sandy and the variety and number of shells greatly increased. Finally the entire deposit consisted of fine sand and clay, with minute univalve shells in astonishing quantities. Hillocks formed by drifting sand accumulating around clumps of mesquit bushes, leaving only the branches exposed, gave some variety to the surface of the plain. A few black Tabanis (horse-flies) came buzzing about the horses, and a large spotted-winged Libellula flitted by us. The presence of these insects was the more remarkable as the distance to water was not less than ten miles. Their appearance, insignificant as were the little creatures, was cheering and relieved the sullen sadness always produced by the total absence of animated beings. At 10½ A. M. we reached water, after thirteen and a half hours' riding; horses much fatigued, hungry and half mad with thirst; water brackish and warm, proceeding from a large fountain which rises up in the bed of a ravine, boiling and bubbling with the constant evolution of gas—probably carbonic acid. It runs off northeast in a stream yielding about 500 gallons per minute; but within half a mile it is lost in the porous soil, and there is no further trace of it. The ravine in which it rises comes from the southwest, and is probably a continuation of Cariso Creek. It here forms a little valley some hundred yards broad, covered with bushes and coarse grass—among which the stream meanders from side to side of the valley. The depression below the common level of the desert is about forty feet. I will take occasion to mention here that appearances presented by the bottoms of ravines, wherever I observed them, indicated that water might anywhere be found at a depth not exceeding forty feet. A small grove of mesquit trees, (Prosopus glandulosa) with a heavy crop of dry legumes, stood on the brink of the ravine. The fruit formed a welcome repast for the horses, and the slight shade of the scattering boughs afforded us some protection against the sun-rays; with blankets spread over them a tolerable shade was produced, but afforded no barrier to the parching blasts of wind that came like the breath of an oven. I was driven to the water, where, with the tall rushes bent into a kind of bower and sitting up to the neck in the stream, I voted myself the presiding genius of the place, and half dozing, rested comfortably for an hour.

"At 5½ o'clock, P. M., started again, hoping to reach the volcanoes by midnight. To lighten the burden of the animals, all our provisions, blankets and extra wearing apparel, were left behind; taking no weight save our arms and supply of water. Two black butes, betwixt which our course lay, in a north-easterly direction, served us as guides. Within two miles, we came to a small stream of water, rising in a ravine but not

sunk more than fifteen feet below the plain. It ran toward the north a very little way, and was lost by evaporation and absorption. Beyond this, we crossed a superficial clay ridge, strewn with pebbles and fragments of obsidian; near sun-down entered a sandy district, the horses sinking fetlock deep each step; after dark the butes being no longer visible, kept our course by the stars. By-and-by the atmosphere became hazy, and only occasional glimpses could be had of the stars. Wandering from our course we got into loose, drifting sands, thrown by the winds into ridges and hillocks, through which the animals plunged and struggled, and finally we had to dismount and lead them. José declared himself lost, and refused to go any farther till morning. There being no means of securing the horses, in case of a halt, we continued to toil on, and fortunately got off the sand banks in a little while. Soon, a few sage bushes were encountered, and selecting the stoutest, the animals were fastened to await the coming of to-morrow. In attempting to make our beds, the burning temperature of the earth required the interposition of saddle-blankets and leathern covers of the saddles, and still it seemed like submitting our limbs to the process of baking. The restlessness of the horses kept us in constant fear lest they might break the insecure fastenings and leave us in a rather unenviable predicament. It is useless to say the night was not passed in refreshing slumbers, and the dawn was never more welcome.

"*July* 19.—At daylight it was found that we had wandered last night too far to the north, and had to turn to the south and east. The white clouds of steam, shooting upward from the Salse, soon became apparent at the distance of ten miles. At sunrise the steam-jets presented an imposing and singular appearance; the cones from which they issued were distinctly visible, and the dull roar of the subterranean tumult could occasionally be heard. The black butes that served as landmarks yesterday lay on either hand—that to the left less distant. It had the appearance of a mass of lava heaped into a rough and fantastically irregular hill, crowned with sharp pinnacles and rude arches, as if the whole had been hardened suddenly while in a state of most violent agitation from boiling. The more distant one to the right seemed a black, compact mass, with a glittering smooth surface, common to the granite and gnisease rocks bordering the desert. If volcanic, the character was not so apparent as in that to the left.

"A little after 6 P. M. reached a point as near the Salse as was deemed prudent on horseback. The ground had become soft and muddy, and the sulphurous scents and strange sounds frightened the horses. Giving them in charge of José Serano, we proceeded on foot about a quarter of a mile to the scene of action. The scene presenting itself is difficult of description. The effect can only be known by one who has heard the wild rush of steam, the rude sounds of the mud explosions, and the dull murmur of the boiling cauldrons of slime. The space occupied by the Salse is a parallelogram, five hundred yards long and three hundred and fifty broad—a table of hardened bluish clay, a little elevated above the surrounding plain. The adjacent ground is low and muddy, and during the rains is entirely covered with water. There is a gentle slope towards the north and east, the mud and water of the Salse running off slowly

in that direction, where a lake of salt water exists in the rainy season, but presenting now a vast sheet of crystalline chlorid of sodium. Into this lake the arm of the Colorado, known as New river, discharges itself. The lake, having no outlet, would probably soon regain its ancient area if the channel of New river afforded a regular and more generous supply of water.

"The steam-jets of the Salse issue from conical mounds of mud varying from three to fifteen feet in height, the sides presenting various angles, some being sharp and slender cones, others dome-shaped mounds that seem to have spread and flattened out with their own weight, upon the discontinuance of the action that formed them. Out of some of the cones the steam rushes in a continuous stream, with a roaring or whizzing sound, as the orifices vary in diameter or the jets differ in velocity. In others the action is intermittent, and each recurring rush of steam is accompanied by a discharge of a shower of hot mud, masses of which are thrown sometimes to the height of a hundred feet. These discharges take place every few minutes from some of the mounds, while others seem to have been quiet for weeks or months. During our short stay we had specimens of the rapidity with which a sharp, conical mound could be built up and again tumbled down. In one place a stream of hot water was thrown up from fifteen to thirty feet, falling in a copious shower on every side, forming a circle within which one might stand without danger from the scalding drops, unless the wind chanced to drive them from their regular course. It issued from a superficial mound out of an opening about six inches in diameter; but the column of steam and water, immediately upon issuing, expanded to a much greater size. The orifice was lined with an incrustation of carbonate of lime, and around it, and particularly on the southeast side, stood a miniature grove of slender stalagmitic arborescent concretions of the same substance. They were from half an inch to one and a half inches in diameter, and from four to eight inches in height. Many of them were branched and the tips colored red, contrasting beautifully with the marble-whiteness of the trunk, and resembling much a coral grove. Some were hollow, and delicate jets of steam issued from their summits, and this seemed to explain the mode of their formation. Some were not hollow throughout, being closed at the summit, but when detached from their base, a small orifice in the centre suffered hot steam to pass, and some degree of caution was required to remove them without scalded fingers. To approach the spot was a feat of some difficulty, surrounded as it was by a magic circle of hot rain. I retreated, scalded, from the only attempt I dared to make; but my son, more adventurous or more attracted by the beauty of the specimens, succeeded in bringing away several. The falling water ran off into a pool a foot deep, but what became of it was not apparent, as it had no seeming outlet. I brought away a bottle of it for examination. It was transparent, but had an intensely bitter and saline taste. A little beyond on either hand, are two huge cauldron-like basins, sunk five or six feet below the general level, and near a hundred feet in diameter. Within these cauldrons a bluish argillaceous paste is continually boiling with a dull murmur, emitting copious sulphurous vapors, and huge bubbles, bursting, throw masses of mud to the height of several feet. These kettles sometimes boil over,

and the matter runs off in a slimy stream toward the salt lake. This seems to have been the case recently, as we encountered the track of one of these streams, not yet dry, a mile from the Salse.

"The volcanic action was far more violent at some former period than at present, as is proved by the erupted bute, above named, as well as by fragments of pumice scattered over the plain.

"Our visit lasted only an hour and a quarter. The sun was already scorching hot, and our supply of water could not last, with the most rigid economy, more than three hours longer. The watering place, left yesterday, was not less than twenty miles distant. A spring was marked by the United States surveyors, only four or five miles to the north, but as no land-marks were known by which it might be found, it would have been rash to waste time in seeking it. The tempting objects in the vicinity, which would require many days for examination, could only be greeted with a farewell glance, and our horses' heads were turned towards the water. Leaving the sand-hills, that gave us so much trouble, to the right, our course lay southwest.

"We soon had reason to congratulate ourselves upon being clear of the drifting sands. The winds increasing as the day advanced, whirled the dust into a black cloud, through which José declared it would be impossible to travel. It would certainly have been exceedingly unpleasant, to say the least. The season of the rains was due—the Sonora rains prevailing here—and showers were observed at a great distance, but none approached us.

"For the first three or four miles after leaving the Salse, the plain presented a smooth surface of sand and bluish clay, baked and fissured, and strewn sparingly with volcanic cinders and obsidian fragments. Round holes marked the escape of gas when the ground was softened by water. Soon the plain became cut up with ravines three or four feet in depth, which José said were the arms of 'New river,' which branched out before entering the salt lake. The remains of a most luxuriant vegetation, now dead and dry, proved the place to be a desert only for want of water. The suddenness and rankness of grass and weed growth where the New river broke away from the Colorado, some years since, and irrigated the desert, is remembered by many who witnessed the magic-like transition from barrenness to fertility. An intervening sandy district confused our course—loose and drifting but not deep—and fortunately no sand-storm was gotten up for our benefit while passing it.

"It was now near noon; the wind blew a gale, but seemed only to add, by its scorching dryness, to the raging solar heat. Our water bottles were exhausted, and the distance betwixt us and the watering place was yet ten or twelve miles. Two hours' deprivation of water is certainly no great inconvenience under ordinary circumstances, but on the desert can only be appreciated by one who has felt it. About 2 o'clock, P. M., the green bushes and cheerful rippling of water greeted us, and men and horses plunged in and blessed the fountain in the desert.

"The tired condition of the animals made it imprudent to leave our present position until they were somewhat recruited, so arrangements were made for a shelter from the sun. A black cloud that had been slowly

heaving up for some hours from the west, at last met the sun's track and brought its friendly shadow to our relief. After a refreshing nap of two hours an attempt was made at getting up a breakfast—we had eaten nothing during the day—but all appetite was gone, and nothing craved but continued drafts of water. José, however, was a bright exception, and had certainly lost nothing of his gastronomic powers, but merrily devoured the meal prepared for the three.

"As night closed in two or three black bats came forth from their hiding places, and a solitary goat-sucker flitted around in silence. No other animals appeared, save a lizard, whose movements were too quick for us to capture him, and three Coleopterous insects, which, less agile than their neighbor, fell a sacrifice to the interests of science.

"On the morrow—Monday, the 20th—it was still thought imprudent to leave until evening, so as to make the most of the journey to San Felipe during the night and early the following day. The forenoon was therefore spent in collecting a few shells from the soil, one of which, the Physa humerosa, was still found inhabiting the water of the spring. Two species of fishes were observed about an inch in length, one slender and of a whitish color, the other broad in proportion to length, and dark colored, looking like a small perch. Our guide states that this secluded spot was his early home. He was born here, and the tribe he now rules over here had their lodges, and lived in abundance on the maize, melons and frijoles that he describes as growing with a luxuriousness unknown to any place away from the so-called desert. A succession of rainless summers drove them away, and they have not since returned. They planted with the early rains, say in July or August.

"At 4 P. M. bid adieu to our camp and set out for San Felipe. About midnight we arrived on the margin of the Cactus thicket—the scenes of my former mishap.

"*July* 21.—At daylight again on the move, and startled a vagrant coyote, the only one ever seen in our route. A trail of a flock of mountain sheep was observed, and the head of one, probably killed by Indian hunters, lay by the wayside. At 10½ A. M. the welcome sight of San Felipe cheered us from the heights above it, and a half hour found us safe under the hospitable roof of Messrs. Smith & Brill."

Thus ended a hurried trip to a most interesting spot in the midst of a no less interesting district. The shells obtained were submitted to Dr. Trask, and were found to consist of two species of Amnicola (A. protea and A. longinqua, Gould) and the Physa (P. humerosa, Gould) before named. A large bivalve was observed, but so thin and fragile that the specimens broke to small pieces for the want of safe means of transporting them.

The water from the volcano has the specific gravity of 1·075, and holds in solution free *boracic acid*, with *borates* and a large quantity of chlorid of sodium. and other salts. These matters would indicate the true volcanic origin of the Salse, and but little doubt rests on my mind of its being so. The evidence of former volcanic action in the neighborhood, and the testimony of the boracic acid, establish its true character. The acid and its compounds exist only in small quantities, but sufficient to be unequivocally determined. Similar Salses exist some thirty or forty miles farther south. One made its appearance during the earthquake of November 29,

1852, a few miles below the line of the State. Two others exist in the same district, as I was informed by a person who professed to have visited them. One is represented as a single jet of steam and water from an opening a yard in diameter, situated in a plain of hardened clay. The other consists of several pools of warm water, through which hot gas is continually escaping. Another is again spoken of in the adjacent mountain, partaking of the true volcanic character, emitting fire and smoke. I hope some one will soon have occasion to examine these and other interesting localities at a season when it will be practicable to pass a few days on the desert without danger of perishing from thirst.

The real character of this desert has not been generally understood. In its present condition it is truly a desert. But only a portion, however, of its immense area is condemned to irretrievable barrenness—viz: the part covered with drifting sands. The greater part, from the constituents of its soil, must be fertile in the extreme, and only wanting moisture to produce a wilderness of vegetation. This is proven in the case of New river, while it continues to run. This arm of the Colorado might be made permanent, but a far more convenient supply could be furnished by Artesian wells, or better still, by wind-mills raising water from common wells, as is now so successfully practiced throughout the fertile valley of San José. As stated before, there is every reason to believe water can be had anywhere at a depth not exceeding thirty or forty feet.

As the great Southern Railway must pass through this district, it is interesting to know that the now dreaded desert can easily be changed into the happy homes of a thriving people. Repulsive as are at present the features of the country, the presence of a railway will convert it into the garden of the Pacific slope, and it is destined to become the cotton and sugar growing district for Arizona, Utah, California and Oregon.

Since writing the above I have had the pleasure of seeing a letter from Dr. Newberry, Geologist of the Colorado Exploring Expedition, fitted out by the United States government, to Dr. W. O. Ayers, of San Francisco, from which I am kindly permitted to make an extract. Speaking of the desert, he says, "I find it not a bad country—having, most of it, a better soil than the mountain district west of it. If water could be supplied regularly to the New river country it would be a perfect garden."

3. *Gutta Percha of Surinam.*—Professor Bleckrod of the Delft Academy, has recently given a notice of the gutta percha of Surinam. Although gutta percha has been known in Europe for a dozen years, and has now come into general use, yet much still remains to be done regarding it, both as respects its uses and its sources. The Professor states that Dutch Guiana can supply gutta percha. This is of importance, when we consider the value of the article, and the probable exhaustion of it in the countries from which it is now supplied. The Dutch Government took measures to transplant the *Isonandra Gutta* and cultivate it in Guiana; but they have lately discovered in that country a species of Sapota, to which Blume gives the name of *Sapota Mülleri*, which yields a juice in every way equal to that of the Isonandra. It is probable that other trees of the same natural order may be found to yield a similar product. *Achras Sapota*, the fruit of which is known in the West Indies as Neesbery, also yields a milky juice like gutta percha. *Sapota Mülleri* of

Blume is probably the tree called "Bullet-tree" by the English, and its wood is known as "horse-flesh." It is a tall tree, yielding in summer a large quantity of milky juice. It appears that under the name of common Boerowe, or Bullet-tree, these have been confounded: 1, the *Lucuma mammosa* of Gærtner (Marmalade tree)—the Mimusops of Schomburgk; 2, the white Boerowe, which is the *Dipholis salicifolia* of Alph. D.C., and is known in Jamaica as Galimata; 3, the bastard Boerowe or Lowranero, which is the *Bumelia nigra* of Swartz; and 4, the Neesbery Bullet-tree, or *Achras Sideroxylon* of botanists, which yields one of the best of the Jamaica woods. *Sapota Mülleri* grows abundantly on slightly elevated situations. In collecting the milk the trunk is surrounded by a ring of clay, with elevated edges, and then an incision is made in the bark as far as the liber. The milky juice flows out immediately, and is collected in the clay reservoir. The juice resembles in some respects the milk of the cow. It forms a pellicle on its surface, which is renewed after removal. By the evaporation of the juice, we obtain 13 to 14 parts in 100 of pure gutta percha. This Surinam gutta percha is said to be sold at Amsterdam at the same price as the best gutta percha of commerce.—*Edinb. New Phil. Jour., April*, 1858.

4. *On Earthquakes in California during the year* 1857; by Dr. J. B. Trask, (Proc. California Acad. Nat. Sci., page 108, May, 1858).—During the past year there has been rather a frequency in the occurrence of the phenomena of earthquakes, and, with the exception of two, there have been none that were particularly remarkable either for extent of surface affected or severity of action. In one, that of the 9th of January, the greatest extent of surface, and greatest intensity of action was manifest. Its principal force seems to have been expended in the more southerly portions of our State, and in the immediate vicinity of those volcanic vents found at different localities upon the Colorado Desert. It is manifest, however, that this shock and those which preceded it on the night of the 8th, had their origin to the west of our coast, as the times of occurrence of the shock at different localities most fully prove. This matter was fully discussed in my previous paper, "On the direction and velocity of the Earthquake of January 9th, 1857," read before this Society March 30th, which will be found on page 98 of their Proceedings.*

The other shock of greatest extent, on the 2d of September, extended over an area of about 200 miles, but was marked by no particular severity or injury except that of fright to those who experienced it.

The whole number that can be authenticated as occurring during 1857, amounts to seventeen, being greater than the number recorded in 1853 and 1856, and it would seem probable from our records that this number is the maximum to which we shall probably be subjected in this State.

From the Sandwich Islands we have no news of earthquakes save one, which is here inserted: "A very severe shock of earthquake was felt at Kawaihae, Hawaii, on the 24th of February, the most severe that the residents there have had for many years."

The arrival of the whaling fleet from the northern seas brings no intelligence of the occurrence of these phenomena, as was the case of the preceding year, and hence, the presumption is, that subterranean action has not been violent in those distant regions during the year just passed.

* See this Journal, vol. xxv, 146.

On the coast of Mexico, over the region between the 25th and 32d parallels, we have received intelligence of the occurrence of one earthquake, which appears to have been felt on both shores of the gulf of California for a distance of nearly 200 miles, both north and south. We have no records south of that point.

The shocks which we can authenticate within the limits of our own State, are as follows:

Jan. 9: This shock was felt from Sacramento to the southern boundary of the State. It was preceded by three smart shocks the night and morning previous. The time of its occurrence at this city was 8^h 13^m 30^s.—18th, 9 A. M.: A light shock at Martinez and Benicia.—20th, 8.30 A. M.: A smart shock was felt at Santa Cruz and Mission San Juan.—21st, 11 P. M.: On the evening of this day a smart shock was felt in Mariposa. The wave and sound seemed to travel from N. W. to S. E. It was accompanied with a report like that of a distant gun.

Feb. 5th, 7 P. M.: A smart shock was felt in San Francisco, which shook the buildings that are situated on made ground very severely, while those situated on firmer bottoms were less affected. This shock was felt at Oakland and Stockton, but was not felt at San José or Sacramento, as reported at the time.

March 14th, 3 P. M.: A severe shock was felt at Santa Barbara and Monticito. It was momentary in duration, attended with a loud report. —23d, 12.27 A. M.: A light shock in San Francisco.

May 3d, 10 P. M.: A smart shock at Los Angeles and the Monte.—23d: A light shock at Angeles; a report also that a severe shock had been felt at Fort Tejon.

June 14th: A shock was felt at Humboldt Bay. On the same day several severe shocks were experienced at the penal island, Carmen, Gulf of California, which extended almost ninety miles north and south of the island.

Aug. 8th, 11 A. M.: A smart shock was felt at Rabbit Creek, Sierra county.—29th: A severe shock at the Tejon Reserve. No time is given.

Sept. 2d, 7.45 P. M.: A light shock at San Francisco. This shock was felt at Sacramento, Marysville, Nevada, San Juan, Downieville and Camptonville.—14th, 2 P. M.: A light shock in San Francisco.

Oct. 19th, 6.30 P. M.: A severe shock of an earthquake in San Francisco. On the following morning, at 12.8 A. M., at 12.35 A. M., and 1.15 A. M., three other shocks occurred; the last, at 8 A. M., was equally severe with that of Jan. 9th. People were much frightened, and left their beds. The shock was felt at San José, but not at Oakland.

Nov. 8th, 3.45 A. M.: A shock at San Francisco, which was felt at Oakland and Bodega.

Dec. 23d, 7 A. M.: A light shock at San Francisco.

Of the whole number which have occurred during the year, two only have been felt at San Francisco that were not experienced at other localities, and four others have occurred which have been felt in common at other portions of the State; thus making about one-third of the whole number that were in common here and elsewhere.

Eight of the aggregate have occurred between the summer and winter solstices. Seven have occurred during the spring and summer months,

and ten during the winter and autumn. Eight have occurred between the vernal and autumnal equinoxes.

5. *The Connecticut Earthquake.*—On Tuesday night, the 30th of June, an earthquake was felt at New Haven and other places in its vicinity. At about $10\frac{3}{4}$ o'clock, P. M., a rumbling sound, similar to the passage of a carriage over a bridge, but more sonorous and more protracted in its movement, attracted the attention of many, besides a jar given to houses and the rattling of glasses. The movement was distinctly perceived to be traveling from southwest to northeast, and continued for something more than a minute. No damage was done to anything in the city of New Haven, nor, so far as we have been able to learn, in any portion of the State. The shock was felt in Bridgeport, Milford, Woodbridge, East Haven, and North Haven—all towns which lie in a southwest or northeast line from New Haven, and this fact may assist in determining its course. At the time of the shock the sky was clear and the air was perfectly still, though in that respect it did not materially differ from its general condition, in the centre of the city, through the evening. In Derby, the earthquake was felt, perhaps more sensibly than in New Haven. The houses, and even the large stone factories in Ansonia were shaken, and the watchmen alarmed by the movement of the earth.

6. *Reflections by the Clouds in the Catskills, near the Mountain House,* (from a letter to one of the editors).—There had been rain in the morning (July 31st) and also the night before, but it ceased in the afternoon, and we had all gone often to the piazza and to the windows to gaze on the *cloud-land* below us,—sometimes appearing like a wide plain of snow with banks and drifts,—sometimes suddenly opening just enough to disclose a house or field and then closing as suddenly. About half past six o'clock, P. M., as I joined again the assemblage on the rocks a little south of the hotel overlooking the valley, the valley appeared like one vast sea of mist or cloud nearly to our feet; grayish clouds were hovering over it in the south, and before me (east) I saw myself in a circular rainbow, brightening till a second pale inside circle surrounded the first, like a halo, but with a little amber-colored space between them. And what I saw of myself, each one saw of himself, and only of another when in close contact. As I moved my arms or head, the image moved; sometimes the circle deepened in tints, at others paled, as the sun shone brightly or was obscured by passing clouds. Shortly after, the sun went into a cloud and the vapors rolled away from the valley. But in a few minutes the valley and mountain side were again shrouded in heavy white clouds, and soon the sun again shone out; but it was so much nearer its setting, that when the vision reappeared it was thrown farther off, and was different in many respects. The reflection was not in a circle, but a long horizontal oval, and the rainbow tints were much paler; besides, the picture was not of an individual only, but of the group of two or three persons observing it, and of the irregular outline of the edge of the mountain precipice with the scattering wild plants growing on it. The first picture seen by us seemed as if nearly perpendicular on the cloud in front of us, which rose white and solid half way to the zenith with an arched outline; above and beyond and behind was clear sky, except the little flying clouds in the western horizon. M. S. J.

7. *Meteoric Stone of Borkut.*—This stone, according to Dr. Franz Leydolt (Sitz. Wien, xx, 398), fell on the 13th of October, 1852, at 3h P. M. at Borkut in Hungary. It was found two feet under ground, and still warm. The largest piece weighed 7 Vienna pounds and 6¼ loths, and the whole 12 pounds. The exterior is partly black or dull gray and much blebby or subscoriaceous, it being covered with a thin crust. The interior is ash-gray, and irregularly fine granular. Its specific gravity is 5·242. It afforded 18·26 p. c. of magnetic material, and 81·74 non-magnetic. The former was found to contain, Iron 85·14, nickel (with some cobalt) 10·06, copper and tin 0·40, sulphur 4·19, phosphorus 0·18 =99·97. Separating 11·53 as FeS^2 the composition of the iron corresponds to Iron 87·96, nickel 11·38, tin and copper 0·46, phosphorus 0·20.

The non-magnetic part was partly soluble in muriatic acid. The soluble and insoluble parts consisted of—

	S̈i	Ä̇l	Ḟe	Ċa	Ṁg	K̇	Ṅa
1. Soluble,	36·16	3·07	21·43	1·20	36·34	0·50	1·27
2. Insoluble,	57·29	4·20	12·08	3·90	17·67	1·14	3·72

The soluble part corresponds nearly to olivine; the insoluble to 34·93 p. c. oligoclase and 65·59 pyroxene. From these two analyses, there were excluded: from the *first*, before deducing the percentage, 0·82 sulphuret of iron, and 13·09 nickeliferous iron; from the *second*, 1·60 chromic iron.

8. *Geological Survey of Canada:* Sir W. E. Logan, F.R.S., Director. *Figures and Descriptions of Canadian Organic Remains*, Decade III. 102 pp., 8vo, with 11 plates.—This third Decade on the Organic Remains of Canada is the first yet issued. No. I is prepared by J. W. Salter, and nine out of the ten plates are already engraved. No. II is by James Hall of Albany, and will treat of Canadian Graptolites; there are to be sixteen plates, of which six are already engraved. This *third* number is by Mr. E. Billings, who has been appointed the palæontologist of the Survey, and treats of the Cystideæ, Star-fishes, and bivalve Crustaceans. It is a work of great merit, enlarging our knowledge of one of the obscurest departments of Palæontology. Besides Cystideæ and Star-fishes, a new genus called *Cyclocystoides*, containing discoid species of Echinoderms, is described by E. Billings and J. W. Salter.

It is remarkable that the Canadian Lower Silurian rocks have furnished twenty-one species of Cystideæ, while in New York only one has been found in the rocks of that age. We have not space for an abstract of the author's views on the Cystideæ and Crinoids. We only mention with regard to the latter that he gives reasons for holding, and apparently sufficient, that the ambulacral openings are at the base of the arms. This is a point which the abundant specimens in the western limestones would easily settle.

We are happy to add that copies of this Decade are on sale in the bookstore of B. Dawson & Son, Montreal, at a moderate price. It is too often the case in this country that the Reports, made under government orders on scientific subjects, are inaccessible to those who would value them.

A fourth Decade is in hand which will illustrate the Crinoids of the Canadian rocks.

8. *Gallerie Ausgezeichneter Naturforscher.* George André Lenoir publisher, Wien.—This "gallery of distinguished men of science" is a folio volume of one hundred lithographic plates, each containing a single portrait, and each portrait accompanied with a leaf of text. The few plates we have seen are engraved in the highest style of the art. The hundred portraits are led off by "Alexander Freiherr von Humboldt;" and following him there are three or more in each of the departments, Mathematics, Physics, Chemistry, Astronomy, Meteorology, Geography, Geology, Mineralogy, Botany, Zoology, Anatomy, and Physiology. Three of the names are American. The physicists included are: Amici, Baumgartner, Biot, Brewster, Ettingshausen, Faraday, Hansteen, Herschel, Jacobi, Magnus, Müller, Neumann, Plücker, Poggendorff, Pouillet, Weber, and Zantedeschi. This splendid work is to be issued at Vienna during the year.

9. *Obituary of William Scoresby;* by Dr. Christison, in his address to the Royal Society of Edinburgh, (from the Edinb. New Phil. Jour., [2], vol. vii, 314.)—The biography of William Scoresby* belongs not so much to us as to the parent Society of the sister kingdom. But as this remarkable man frequently visited us, joined us as an Ordinary Fellow, sometimes contributed to the business of our meetings, and was in early life a student of our University during the winter intervals of repose from his voyages of arctic adventure, it becomes me to advert shortly to the departure of one so eminent in science, so amiable in disposition, so distinguished for Christian virtue.

Scoresby was the son of an experienced whaler and able navigator of Whitby, in Yorkshire. The father's zeal in his profession was so intense and catholic, that he actually carried off his child to his favorite arctic regions at the age of ten, without the previous knowledge of Mrs. Scoresby —an attached wife, and no less fond a mother. The idea, it must be added, did not occur to the father till he one day detected, with much trouble, the urchin hidden below in the Resolution, while the "Blue Peter" was flying from the mast-head, and when the boy had a clear intention of running away from home in this remarkable manner. Entering thus early on a life of fearless adventure, it is no wonder that the second Scoresby outstripped the first in eminence as a navigator. At the age of sixteen, he discovered with his father an open polar sea near Spitzbergen, apparently stretching towards the North Pole; and he actually sailed in it to the latitude of 78° 46′—the highest known to have been ever attained up to that time. At the age of twenty-one he succeeded his father as commander of the Resolution whaler of Whitby; and for twelve years afterwards he annually fished the Greenland Seas, carrying on at the same time constant researches in geography, magnetism, geology, and zoology, for which he had prepared himself by several winters of study under Jameson and other Professors of the University of Edinburgh. The results were published in his "Account of the Arctic Regions," and in his "Voyage to the Northern Whale Fishery."

A deep, pure vein of piety, fostered by careful early training on the part of his parents, everywhere pervaded his pursuits, whether professional

* The death of Dr. Scoresby was announced in this Journal, in vol. xxiii, p. 448.

or scientific. No whale was hunted, and no other work that could be dispensed with was done by the crew of the Resolution on the Sabbath. Their captain was constantly as assiduous in maintaining the religious condition of his men as in preserving their health, and availing himself of their seamanship. But it is also recorded of him, that he generally contrived to reward the forbearance of his men, while their game was sporting securely on all sides around them on Sunday, by insuring that they should make prize of a whale or two at the first entrance of the hours upon Monday morning.

The depth and sincerity of his feelings as a responsible being he has recorded in his "Sabbaths in the Arctic Regions." The ultimate consequence of his following this bent of his mind was, that, while still in the prime of life and vigor, he deserted his favorite the sea, studied at Cambridge for the English Church, took, soon afterwards, the degree of Doctor of Divinity, and became a zealous and efficient member of the ministry, first among his co-mates as chaplain to the Mariner's Church at Liverpool, and eventually at Bradford, as pastor of an extensive manufacturing population.

The ardent and conscientious discharge of his religious duties, however, did not prevent him from applying also to the favorite scientific pursuits of his youth. Only a year before his death, indeed, he undertook a voyage to Australia, for the purpose of testing his theory respecting the aberration of the compass in iron ships; and one of his last scientific observations was the measurement of the ocean wave in a storm off the Cape of Good Hope, when he ascertained that the elevation of the highest, when the sea "ran mountains high," was forty feet from trough to crest.

I cannot, consistently with the indispensable brevity of this sketch, even so much as enumerate Dr. Scoresby's many contributions to science; but must now hasten at once to the close of this theme. Scoresby died, after a tedious illness, at a fair old age, in his sixty-eighth year. Few men can at that age console themselves with the retrospect of so long an existence so usefully spent. The intrepid seaman, the skillful navigator, the philosopher of no mean order, and the pious divine, was throughout his entire life full of good works in each and all of his multifarious vocations.

10. *Death of Bompland.*—Aimé Bonpland, the eminent naturalist, died May, 1858, at San Borja, at the age of eighty-five. Bonpland was born at Rochelle in 1773. He was the son of a physician, and was brought up to his father's profession; but the political events of the early Republic compelled him to enter the navy. He made a long cruise as a naval surgeon, but took the earliest opportunity of returning to Paris to pursue his studies. There, at the house of Mr. Corvisart, he made the acquaintance of a young German of about his own age, who afterwards became known to the world as the celebrated Alexander von Humboldt. These young men became intimate friends, and when von Humboldt undertook his expedition to the equinoctial regions of the new world, Bonpland accompanied him. During this journey Bonpland collected and classed upwards of six thousand plants, which were then unknown to botanical writers. On his return to France he presented his collection to the Museum of Natural History, and received the thanks of Napoleon I., who granted him a pension. The Empress Josephine was very fond of Bonpland; she made him her factor at Malmaison, and often sowed in

her garden there flower-seeds which he had brought from the tropics. After the abdication at Fontainebleau, Bonpland urged the Emperor to retire to Mexico to observe events. A few weeks after tendering this fruitless advice, he sat by the death-bed of Josephine, and heard her last words. Her death and the definitive fall of the Empire, leaving him nothing to desire in France, he returned to South America, and became a professor of natural history at Buenos Ayres. Subsequently he travelled across the Pampas, the provinces of Santa Fé, Chaco, and Bolivia, and penetrated to the foot of the Andes. Being there taken for a spy, he was arrested by the Governor of Paraguay, and was detained a prisoner for eight years, till 1829. On his release he directed his steps towards the Brazils, and settled at San Borja, where, in a charming but humble retreat, surrounded by orange groves and shrubs, he remained to the day of his death, receiving with pleasure all French travellers who visited him. He was the author of many works, among which were *Les Plantes Equinoxiales*, (1805); *La Monographie des Mélastomées*, (1806); *Description des Plantes rares et de la Malmaison*, (1813); *Vue des Cordillères et Monuments Indigènes de l'Amerique*, (1819); and, jointly with von Humboldt, *Voyage aux Regions Equinoxiales du Nouveau Continent.*

We add the following letter from his early friend and companion, Baron von Humboldt (from the London Athenæum of July 24):

Aware of the deep sympathy felt for me by many of my friends, in my great distress at the death of my beloved, noble friend and travelling companion, Bonpland, I have considered it my duty to publish at any rate a short preliminary communication on the subject, for which I am indebted to the friendly zeal of Dr. Lallemant, (author of an important work on the diseases of Europeans in tropical climates). This accomplished man, thinking thereby to give me pleasure, after leaving the Imperial Austrian Expedition on board the frigate Novara, undertook a journey in February last from Rio Janeiro to Rio Grande. and from thence, by Porto Alegre and the former Jesuit Missions, to San Borja, where he erroneously supposed that Bonpland was still residing, as he had since the year 1831. I am in possession of two letters of Dr. Lallemant; one from San Borja, on the Uruguay, dated the 10th of April, another written from the Villa de Uruguaiana, on the 19th of April, 1858, after having conversed with Bonpland at Santa Anna:

"Whilst at San Borja," writes Dr. Lallemant, "I resided with an intimate friend of Bonpland, the Vicar Gay, in whose company I visited the formerly well-kept garden of the botanist, but which is now desolate and overgrown. Mr. Gay had received his last letter from Bonpland towards the end of the year 1857. Subsequently news was received of his serious illness. Letters written with a view to learn the state of his health remained unanswered, and in spite of the short distance it was still uncertain at San Borja whether I should find your travelling companion alive. Bonpland had left San Borja in the year 1853, to reside on his larger estate at Santa Anna, where he long occupied himself in cultivating orange trees of his own planting. The residence of the old man of science (in the Estancia of Santa Anna) consists of two large cottages, the mud walls of which are secured by bamboo poles and a few beams on the thatch. Both cottages have doors, but no windows, as the light is admitted by the

crevices between the bamboo supports of the wall. I was received in a hearty and friendly manner. In spite of the deep lines which a stirring life had imprinted upon the beloved countenance, the eye was still piercing, clear, and full of expression. Spirited conversation, commenced by himself, seemed to weary him much, and he suffered much from chronic rheumatism of the bladder. The privations which he so wonderfully imposes on himself are not in consequence of want or necessary retrenchment, but rather of long habit, great self-command, and characteristic individuality. The Government of Corrientes has presented him with an estate worth 10,000 Spanish piastres—he also enjoys a pension of 3,000 francs per annum from the French Government. He has always practised as a physician, with the most perfect disinterestedness. He is universally respected—greatly prefers, however, solitude, and especially avoids those who come to him for advice and assistance. His scientific zeal remains unabated; his collections and manuscripts are deposited at Corrientes, where he has founded a national museum. On the following morning I found him considerably weaker. The night had been a painful one. I earnestly entreated him to tell me if I could in any way be of service to him, but it was with me as with all his friends—'he was in need of no assistance.' I took leave of him with a sorrowful heart. How gladly would I have prevailed on him to return to the civilized world! But I felt with him, that his time was past. He belongs to the first period of the nineteenth century, not to the second. It appeared to me that your friend was himself affected when I took both his wrinkled hands in mine to bid him adieu. Those who surround him have found his powers failing him much during the last three months. Perhaps the old man experienced the same feelings at parting as myself, who would probably be the last messenger of European birth sent to him from afar off into this wilderness, to express to him, in the name of science, all the reverence, love, and thankfulness which is due to him. I mounted my horse and galloped in a northern direction, across the green plains. No path directed me; I was disturbed by no guide; I was alone with my mournful thoughts on Bonpland sinking into the grave."

How happy was the last letter which I received from Bonpland, from Corrientes, dated the 7th of June, 1857:

"J'irai," said he, "porter mes collections et mes manuscrits moi-même à Paris, pour les déposer au Muséum. Mon voyage en France ne sera que trés court; je retournerai á mon S. Ana, où je passe une vie tranquille et heureuse. C'est là que je veux mourir, et où mon tombeau se trouvera à l'ombre des arbres nombreux que j'ai plantés. Que je serais heureux, cher Humboldt, de te revoir encore une fois et de renouveler nos souvenirs communs. Le mois d'août prochain, le 28, je compléterai ma 84éme année, et j'ai trois (4) ans de moins que toi. Il vient de mourir das cette province un homme de 107 ans. Quelle perspective pour deux voyageurs qui ont passé leur 80éme anné."

This joyous letter, almost expressing a longing for life, contrasts wonderfully with the mournful description of Dr. Lallemant's visit. In Monte Video (according to Mr. von Tschudi) it was believed that Bonpland had died at San Borja, on the 29th of May, but without further particulars. On the 18th of April Lallemant conversed with him at Santa Anna. On

the 10th of May his death was denied at Porto Alegre. There is, therefore, still hope that the younger of the two has not been the first summoned away. At such great distances, uncertainty is often unfortunately long continued,—as evidence, the anxiety on account of Edward Vogel in Central Africa and Adolph Schlagintweit in Central Asia.

Berlin, 12th July, 1858.

Track Survey of the River Parana, surveyed by Commander THOMAS J. PAGE, U. S. S. Water Witch in 1855. Sheets Nos. 3, 4, 5, 6, 7.

DE LA RIVE: Treatise on Electricity. translated for the author by C. V. Walker, F.R.S. *London.* Vol. I (18*s.*) and II (28*s.*), have been published.

HUMBOLDT'S Cosmos, translated by Major General E. SABINE. Vol. IV, part I. *London*, 1858.

J. GLAISHER: Stereoscopic Magazine, a gallery of English and foreign landscape scenery, architecture, antiquities, and natural history, and accompanied with descriptive letter-press by writers of eminence, in their respective departments. The first number issued in London, July 1st; price 2*s.* 6*d.*

Professor POGGENDORFF, of Berlin: Biograph. literar. Handwörterbuch zur Geschichte der exacten Wissenschaften. *Leipzig.* J. A. Barth. This work is a Scientific Biographical Dictionary, giving briefly the time and place of birth and death, profession and principal publications of men of science, both living and dead. The part issued goes half through the letter D. It is prepared with great care, and will be a valuable book of reference.

ALCIDE D'ORBIGNY: Histoire Naturelle des Crinoides, vivants et fossiles, in 4to, with eighteen plates, containing 300 figures. *Paris*, J. B. Bailliere, et fils. 12*fr.*

LACÉPÉDE: Hist. Naturelle comprenant les Cétacés, les Quadupèdes ovipares, les Serpents, et les Poissons. New edition, preceded by a eulogy of Lacépède by Cuvier, and with notes and the new classification of A. G. Desmarets. 8vo, vol. I. *Paris*, 1857.

O. G. COSTA: Ittiologia fossile Italiana (Fossil Italian Ichthyology.) intended as a supplement to Agassiz's work on Fossil Fishes. pp. 1—40, 4to, with three colored plates. *Naples*, 1855–'56.

COTTEAU & TRIGER: Echinides du Département de la Sarthe. 1st Livr., 8vo, 48 pages, with plates. *Paris*, 1857.

G. NICOLUCCI: Delle razze humane, (the Human Races). Vol. I, Fasc. I. viii. and 176 pp., 8vo. *Naples*, 1857.

Dr. C. RITTER: Die Erdkunde im Verhaltniss zur Natur und zur Geschichte des Menschen, &c.; 18th part, 3d book. Asia Minor. 1 vol., 8vo. *Berlin.* $4.13.

A. D'ARCHIAC: Histoire des Progrès de Geologie, Tom. VII, Jurassic Formation, 2d part, 718 pp., 8vo. *Paris*, 1857.

H. v. MEYER: Reptilien aus der Steinkohlen Formation in Deutschland, x and 127 pages, fol., with sixteen plates. *Cassel*, 1858. 27½*ngr.*

C. L. BONAPARTE: Iconographie des Pigeous non figurés par Mme. Knip dans les deux volumes de MM. Temminck et Prevost. Livr. 2—7 fol. *Paris*, 1858.

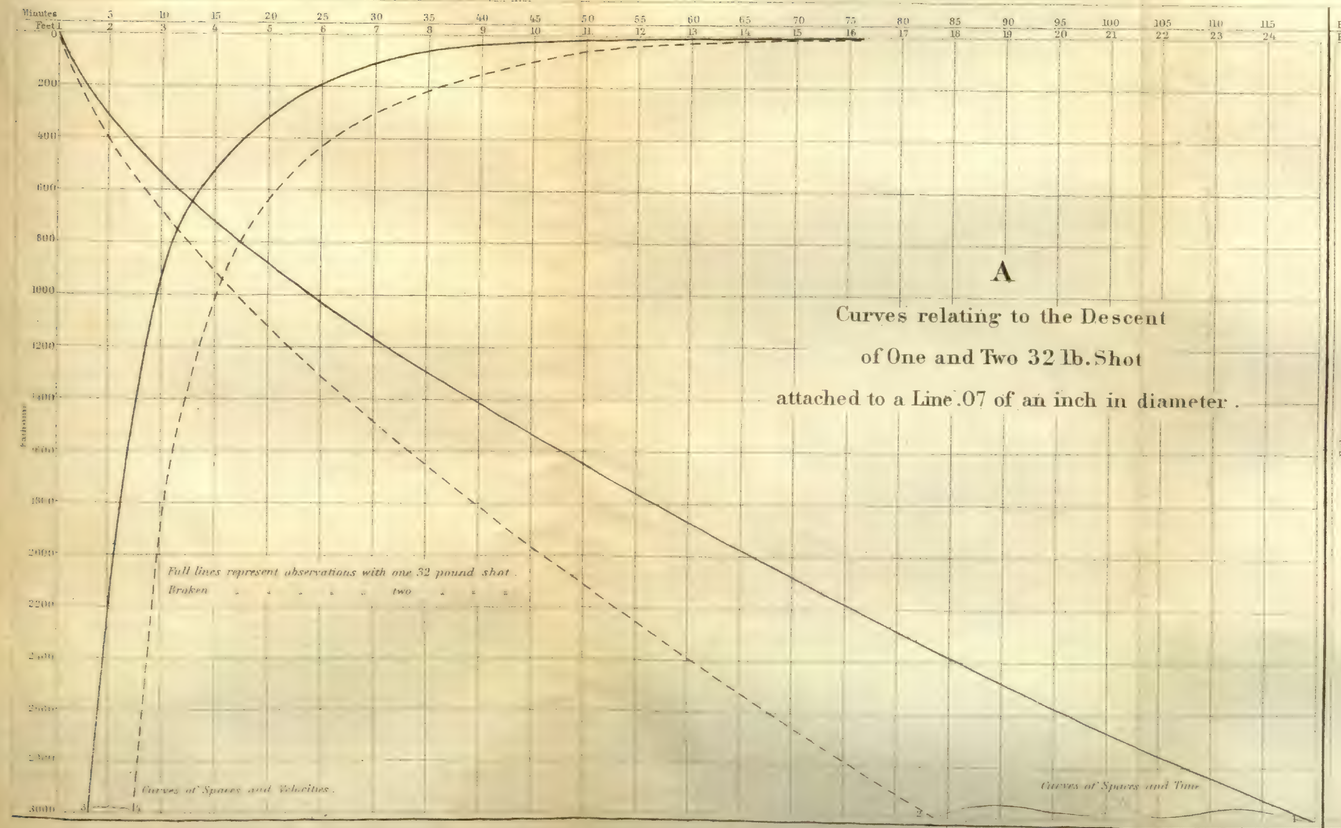
A. LADREY: Chimie appliquée à la Viticulture et à l'Œnologie; 600 pages, 12mo. *Paris*, 1858. 7*fr.*

U.S. COAST SURVEY

A.D. BACHE SUPERINTENDENT

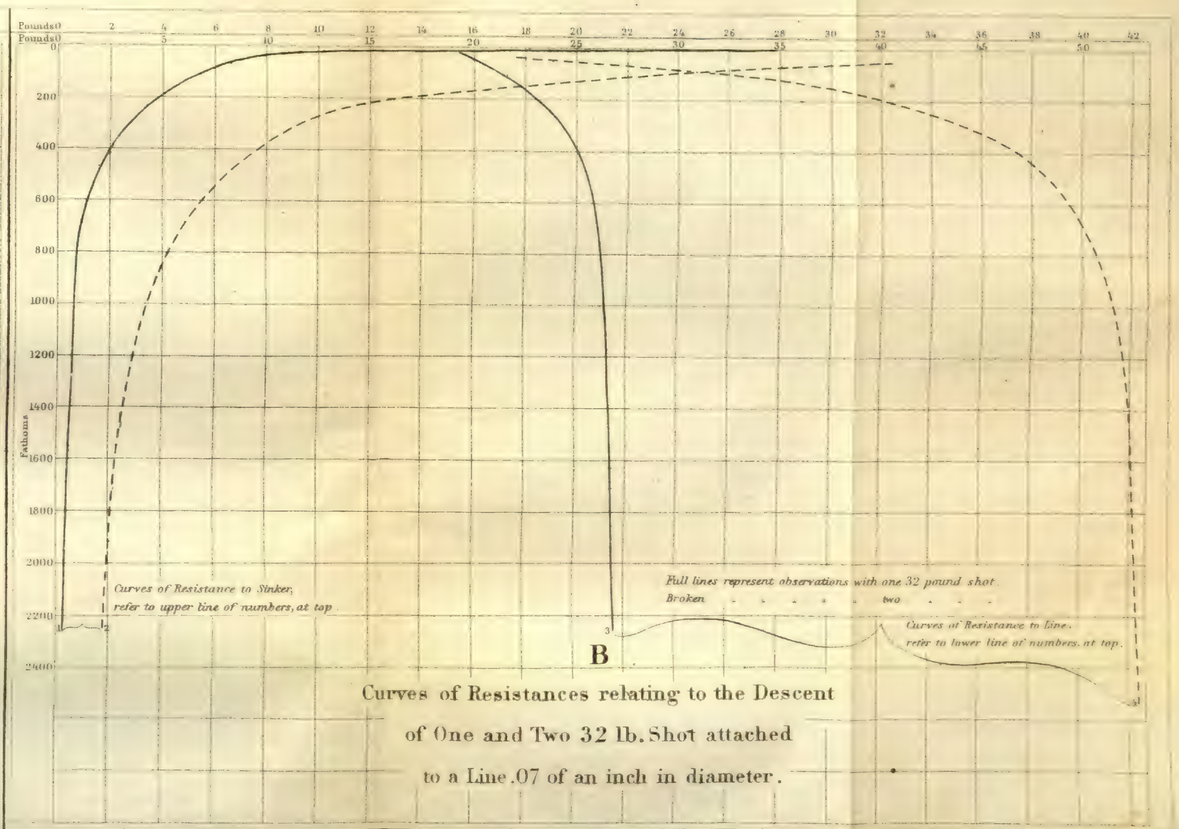
CURVES ILLUSTRATING THE DESCENT OF THE SOUNDING WEIGHT AND LINE IN DEEP SEA SOUNDINGS

1858


Minutes
Feet
Fathoms
Full lines represent observations with one 32 pound shot.
Broken . . . . . two . . . .
Curves of Spaces and Velocities.
Curves of Spaces and Time.

A

Curves relating to the Descent of One and Two 32 lb. Shot attached to a Line .07 of an inch in diameter.


Pounds
Pounds
Fathoms
Curves of Resistance to Sinker, refer to upper line of numbers, at top.
Full lines represent observations with one 32 pound shot.
Broken . . . . . two . . . .
Curves of Resistance to Line, refer to lower line of numbers, at top.

B

Curves of Resistances relating to the Descent of One and Two 32 lb. Shot attached to a Line .07 of an inch in diameter.

THE

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[SECOND SERIES.]

ART. XXXV.—*Observations upon the Practicability of reaching the North Pole*—with a map; by ISAAC I. HAYES, M.D.

Read before the American Association for the Advancement of Science, at its Annual Meeting, held at Baltimore, May 3, 1858.

I VENTURE to trespass upon the time of the Association for the purpose of directing attention to a profitable field of scientific inquiry.

The announcement made by Dr. Kane of the discovery of an open sea within the Arctic ocean, was received by the scientific world with many regrets that circumstances had not afforded an opportunity for a further investigation of the subject. The phenomenon was witnessed at the most remote point reached by his exploring parties, and at a period of the cruise too late to admit of further effort. I wish to call attention to the facilities for doing what could not then be done—for continuing the explorations begun by American citizens upon the most northern lands of our planet. It is for this purpose that I have appeared before this representative body of American science.

Arctic geography has been slowly developed; and while wonderful revelations have been made every year in the torrid and temperate latitudes, until scarcely a square mile of the earth's surface within those limits remains untraversed by the explorer; while time after time the earth has been circumnavigated, the Poles, about which the whole fabric revolves, are enveloped in mystery.

The northern coasts of Asia, Europe and America, have been determined with reliable accuracy; but whether the Russians are correct in their belief in the existence of a great continent lying to the northward of Asia, or whether the Archipelago to the northward of America continues even to the Pole, we do not know; yet, while in the arbitrary divisions of the aqueous portions of the earth's surface, the "Arctic ocean," embraces the watery area within the parallel 66° 33′, we may, I think, safely suppose that, throughout the greater part of the actual coast line circumference of this great Mediterranean basin, we have determined the polar land limit. Of the continental masses of land, any portion of which has hitherto come within the range of exploration, the only one remaining unknown upon its northern face is that of Greenland, and by referring to the rude diagram which I have projected for the inspection of members, it will be seen, that this continent, with the adjacent land of Grinnell to the westward, continuing as already observed farther towards the Pole than any other upon our globe, gives us the most central position for exploration.

I need hardly say that the great difficulty which has been encountered by all navigators who have attempted to penetrate within the polar basin, whether for the accomplishment of the northwest, or the northeast passage, or to reach the Pole, has been the great *ice barrier*, which invests with an irregular line the entire area, and extends in the western Atlantic considerably to the south.

Although the position and movements of this ice barrier are well known to the members—having been so frequently defined—I have nevertheless thought it necessary briefly to sketch its outline.

It is sometimes brought by the great polar current of the Greenland sea and Davis' Strait, as low as the forty-eighth parallel of north latitude off Newfoundland. Continuing thence parallel with the Labrador coast to the sixty-fourth or sixty-sixth degree, its outline forms a bight in Davis' Strait, conformable with the remarkable curve of the Greenland current; thence along the coast southward, it rounds Cape Farewell, and springing over the Greenland sea to Nova Zembla, it invests sometimes Iceland and Jan Mayen; thence eastward along the coast of Asia, it joins America over the Strait of Behring; and still following closely the tortuosities of the shore line, it dips down into Hudson's Bay.

The area invested by this irregular ice coast-line, is not far from six millions (6,000,000) of square miles.

This is not, however, one continuous ice margin, but its southern edge presents a broken outline, penetrable at many points; and through the partial openings caused by currents, tides,

storms, and changes of season, the Pole has been approached from several different quarters. The northern edge which has hitherto appeared as a solid and impenetrable barrier, is much less irregular than the other, and its outline invests a much smaller area. In the line of Baffin's Bay it is not reached until we have advanced nearly two thousand miles to the northward of the point, where the ragged border of the drifting ice presents the first obstruction to free navigation. Dr. Kane was arrested by it in Smith's Strait, in latitude 78° 37′. Scoresby in the whale ship Baffin penetrated in 1822 to the east coast of Greenland, through the broken belt of the polar current, but his northward progress was stopped by an unbroken field, commencing at Gaal Hamke's Land, latitude 75°, and stretching east and north to the regions above Spitzbergen. To the northward of Spitzbergen we lose its continuity, and the conflicting reports of the early Dutch navigators leave us in doubt as to the actual position of the impenetrable barrier. There can be no doubt, however, but that the closest approaches to the Pole by water have been made through this remarkable indentation, known of old as the "Fisherman's Bight." To the eastward of Spitzbergen we meet the solid barrier resting on the northern face of Nova Zembla—about latitude 77°—where it was met by Barentz and others of the earlier navigators; and eastward again from Nova Zembla it follows so closely the trend of the shore that the Russian navigators and traders have been able to accomplish but little more than a slow and precarious passage through the varying channels which, during the summer, separate the coast lines of the ice and land. Above Behring's Strait, Cook, Kellet, and Rogers were checked at latitudes 70° 45′, 72° 51′, and about 73° respectively, and Sir Robert McClure, following the line of the coast eastward from Icy Cape, found an impenetrable barrier continuous to the north coast of Bank's Land. Parry could neither pass to the west nor to the north of Melville Island, and Sir Edward Belcher was arrested in the Queen's Channel, in latitude 76° 52′.

The area invested by a line intersecting these several points of extreme navigation would equal about three millions (3,000,000) of square miles.

Whether this extensive area is a uniform sea of ice—as it has appeared from whatever point observed—has been a fruitful source of conjecture. We were almost wholly wanting in positive knowledge until the present century.

Failing in every effort to penetrate to the centre of the polar basin by water, and discouraged by the fruitless attempts of Baffin, Hudson, Poole, Phipps, and others, it was determined to alter the plan of operations, and boldly push out with sleds upon the frozen sea. From four several points such efforts have been made—by the Russians from the Kolyma and Jana; by the

English from Spitzbergen; and by the Americans through Smith's Strait.

The lead was taken by the Russians. In 1810 Hedenström and Pschenizyn started from the mouth of the Jana with the dog sledges of the native Samoides, in search of a continent supposed to lie to the northward. Ten years later they were followed by Anjou and Wrangel, who were dispatched by the Russian government for the solution of the same interesting geographical problem. The ice over which these several parties travelled was found mostly smooth, both in the outward and return passage, but their northward progress was checked by their coming suddenly upon open water—"a vast immeasurable ocean," as described by Admiral Wrangel—to the northward of Ketelnoi, stretching eastward in the direction of Cape Schelagskoi. The time of observation was the cold months of February, March, and April.

A similar attempt was made from Spitzbergen in 1827, by Sir Edward Parry, using boat sledges and men, instead of dogs, for draught. Parry was carried by the Hecla to Hakluyt Headland on the northern side of the island, and starting upon the solid ice from the Rocks, known as the "Seven Islands of Spitzbergen," a little above the 80th parallel, he made his descent in a due north line. Reaching to latitude 82° 45′, he discovered the whole body of the ice upon which he travelled to be drifting southward, and finding that he was losing ground he was forced to return.

The attempt of Dr. Kane to penetrate to an "open Polar Sea," was made from a point nearly upon an opposite meridian from the line of descent of Hedenström and Wrangel. Like the Russians, he used the dog sledges of the natives. Having been arrested with his vessel by the solid field ice, as already observed, he passed the winter of 1853–'54 at Rensselaer Harbor, in latitude 78° 37′, and early in the spring commenced his sledge operations. The first parties failed in consequence of the roughness of the ice and want of provisions, to reach beyond latitude 80°; but later in the season, a final and more successful effort was made by William Morton and Hans Hendrick, an Esquimaux hunter. Early in June they left the brig with a single team of seven dogs, and replenishing their stock of provisions at a *cache* establishment near the base of Humboldt Glacier, in latitude 79° 12′, they made from this point a final start. After encountering more than the usual share of difficulties and dangers peculiar to ice travel, all of which were overcome with manly energy and determination, they entered on the 20th a new channel opening nearly due north from the N. W. angle of Smith's Strait. This channel, which now bears the honored name of that Secre-

tary of the Navy,* who, obedient to the dictates of patriotism, humanity, and gallantry, gave all the weight of his official position and personal influence toward the organization of the expedition, was found open from latitude 80° 20′ to 81° 15′, the extreme limit of exploration. Here, from an elevation of about four hundred feet, Morton looked out to the northward upon a boundless, iceless sea.

Although these several explorations cover only a comparatively small area, yet their results are harmonious, and point quite clearly to this result viz.: that there is an open sea within the boundaries of the sea barrier as already delineated—a watery area encircled by a belt or zone of ice. That this is the case in summer, there can, I think, be no doubt.

Viewed alone, however, the discovery of those open spaces would indicate nothing. The open area of Dr. Kane did not exceed four thousand (4,000) square miles. That seen by the Russians was at no time as great. Parry did not reach to open water at all, and its existence to the northward of his terminus is only conjectured from the fact that the whole body of the ice upon which he travelled was moving from the Pole. But the many observations made in important localities, give, when viewed together, a positive value to the results separately reported by the explorers. A multitude of causes, local and accidental, might operate to produce the result of open water as above noted; but water seen as a part of a great open polar sea, stands toward other observed phenomena, in the relation of cause and effect.

These observations I have thought of sufficient importance to dwell upon at considerable length.

I will first call attention to the bird-life. Morton reports having seen the cliffs, sea and air, about the open water of Kennedy channel, literally swarming with Brant geese (*Anas Bernicla*), Eider ducks (*Somateria mollissima*), and the Fulmer (*Procellaria glacialis*), and glaucous and tridactyl gulls. Sea swallows (*Sterna Arctica*), dovekies (*Uria Grylle*), and other varieties of waterfowl, easily recognized as familiar friends of other days in Baffin's Bay, crowded the rocky shores and cliffs of the expanding strait. Representatives of these same families have been observed flying northward in the spring from almost every quarter; at Nishne Kolymsk, at Koola, in Lapland, at the mouths of the Mackenzie and Coppermine, and at intermediate points. At Rensselaer Harbor and other stations within Smith's Strait I have seen large flocks flying in the same direction. These birds migrate north to bring forth their young. They are essentially marine, since they draw their subsistence entirely from the ocean, feeding mainly upon *molluscan* and *crustacean* life. Their

* Hon. John P. Kennedy.

breeding places are hence selected where instinct directs to open water.

We are wanting in any connected series of observations beyond a certain line which will give us conclusive results as to the climate about the Pole, but there are many isolated facts which point to considerable modification of temperature, as we pass beyond a point, not yet determined with positive, although within reasonable limits. If it can be shown, as has been assumed, that a milder climate exists at the Pole than a few degrees farther to the south, it must be mainly owing to the influence of open water; if not permanent nor uniform, at least to a greater degree, and for a longer annual period, than further to the south, for an ice covered sea would have all the frigorific effect of a solid body of land.

That a milder climate does exist at the Pole than a little farther south, is clearly shown, or at least strongly indicated, by the isothermal curves, which bend up over the Greenland sea and Behring's Strait, exhibiting a disposition to join together from either side, and to revolve around two centres—one above Siberia, the other above America—giving us the same temperature at latitude 90° as at the arctic circle. Sir David Brewster, when establishing his centres of cold and magnetism, used as a basis the isotherms of Baron Humboldt—which cease at 32° of Fahrenheit's scale—and the material principally of Giesecke, Parry, Erman, and Wrangel, placing them upon latitude 80°, giving them the temperature of zero. Subsequent observations, and many of them of very recent date, in the hands of such able philosophers as Kupffer, Berghaus, Prof. Dove, Capt. Duperrey, and others, have brought these points of maximum cold and magnetic intensity nearer to the continents, and although not yet accurately determined, they have doubtless movable centres near the crossing of the 78th parallel of latitude with the 95th meridian of western and the 120th of eastern longitude.

That the first named of these positions is not far from the true American Pole of cold is shown by the elaborate isothermal charts of Baffin's Bay and vicinity, projected by Chas. A. Schott, Esq., of the U. S. Coast Survey.

An observation, valuable in this connection, will be found recorded in the able report of Mr. Durand upon the Floral Collections of Dr. Kane's Arctic Cruises, published in the Journal of the Academy of Natural Sciences for 1856. By an examination of this report it will be seen that two plants (*Hesperis Pallasii* and *Vesicaria Arctica*) were brought from the lands lying to the northward of the Humboldt Glacier, latitude 81°. These plants do not appear either in the collections made by Dr. Kane during his first voyage, or by myself during his second, farther south upon the Greenland coast. The first named was found by its discoverer, Pallas,

in Russian America, and, by the authority of Hooker, we meet with it upon the same isothermal curve in Labrador. It has not been discovered in the cold zone lying between Labrador and Washington Land, from the 60th to the 80th parallel, either on the Greenland or American side of Baffin's Bay.

The migrations of human life, also, furnish us valuable data. The traditions of the Esquimaux point to the north as the central home of the race. Erasmus Yorke spoke of his mother having come from the north, and when Sacheuse told the inhabitants of Prince Regent's Inlet that he came from the south, they replied that it was impossible, since in that direction there was nothing but ice. Egede and Crantz both assign to the Esquimaux a northern origin, and the inhabitants of Smith's Strait have repeatedly told me of the day when their forefathers used to hunt the reindeer and the musk ox—the *Tooktook* and the *Oomeak*—far away to the northward. These traditions would seem to be borne out by positive observations. The remains of their old encampments are found along the east shore of Smith's Strait, from the 78th to the 81st parallel, and I have discovered the same relics of a numerous colony on the opposite coast near latitude 80°. I believe the northern shores of the lands of Grinnell and Washington will be found numerously peopled, and that the link within the channel has been broken, in consequence of the destruction of the hunting grounds by the gradual enlargement of the great Humboldt Glacier, and the enormous discharge of ice-bergs therefrom, producing a local increase of climatic severity. A similar glacial accumulation in Melville Bay, between latitudes 74° and 76°, has cut off communication between the inhabitants of the head waters of Baffin's Bay and of southern Greenland.

That the central home of the race is nearer the Pole than yet explored, would seem to be indicated by the fact that as we advanced southward the race deteriorates. The most northern known branch of the family is that with which Dr. Kane had constant communication, at the mouth of Smith's Strait, and these people exceed in physical development any others hitherto discovered. In south Greenland they are quite diminutive, so much so that the Northmen who discovered the continent in the tenth century, named them from their diminutive appearance "Skrællings." The same fact is observed in Labrador; and the old Norwegians who in their wild wanderings came early in the eleventh century several degrees lower on the coast, found the same people, with the same characteristics. My excellent comrade, the late Mr. McGeary, has assured me that the natives about Pond's Bay are far superior in physical development to the inhabitants of Labrador. In some of the southern settlements I have found the height five feet four inches (5 feet 4 inches) very

unusual; five feet one inch was thought by Crantz to be a fair average. The Smith's Strait Esquimaux reach frequently to five feet six inches; several measured by me gave five feet seven inches, and one, five feet eight and a half inches. These facts are valuable if we accept the theory that races deteriorate as removed from the parallel of their nativity, and if they inhabit the lands to the north of Smith's Strait, there is there continual open water, for they, like the birds, draw their subsistence entirely therefrom, and like them too, supply their wants from day to day, through summer and winter.

But the most important fact, which we have to consider, are of direct determination—I mean the observed water temperatures and their known influence. The facts in our possession, although few, and confined to an extremely limited number of observers, are nevertheless conclusive as to this one point, viz.: that the great body of the waters of the Polar Basin have a temperature considerably removed from the freezing point; and to the immense frigorific influence acting continually upon them, there is evidently a calorific force antagonistically operating. That the latter holds sway during the summer, and clears the greater part of the Basin from ice during that period, there can be no doubt. How far its influence is felt during the period of the year when the atmospheric temperature sinks below the freezing point of mercury, we have, as already stated, little positive information. There are some observations however upon this point which have interest and value.

Baron von Wrangel at his winter quarters at Nishne Kolymsk, records that the temperature rose in winter and fell in summer with the north winds, and that the "N.N.W., and sometimes the N.E. winds were damp to a degree which was sufficient to wet their clothes;" and according to Mr. Tooke, at Koolo "the cold diminishes during the severest weather with the northerly winds." Barrentz at Nova Zembla found a heavy swell coming from the northward, clearly indicating the close proximity of open water; and the same fact has been noted at the Seven Islands, though I should observe that this only relates to the summer.

Sir Edward Parry, upon whose observations we may always properly rely, found at Winter Harbor, Melville Island, that the north winds were often warm. The same fact was noted by Dr. Kane at Rensselaer Harbor, and although the north and northeast winds were frequently cold during the winter, yet the summer winds from that direction brought sometimes warm and foggy weather, and throughout the year a most curious phenomenon was witnessed upon the north horizon. A heavy mist bank floated there almost continually, and, "mist bank on the north horizon" became a stereotyped entry in our meterological tables.

I give these facts without comment or opinion, and will content myself with grouping them with other observed phenomena.

The water to the S.W. of us was open throughout the winter as well as summer. I saw, in December 1854, a large watery area off Cape Alexander, and as late as the 29th of the following month, Dr. Kane discovered a broad sheet, nearly free from ice, stretching out from Cape Hatherton, forty-five miles to the S.W of Rensselaer Bay. This water was frozen over during February, but we have the testimony of the Esquimaux that to the south of Cape Alexander, at a point opposite Ak-oot-loo-nik, latitude 77° 30′, there was an open sea as late as the middle of March, and in closing his journal entry of the fact, Dr. Kane "questions very much, if such extensive areas as the so-called north water ever close completely;" and this "north water," as the whalers call that portion of Baffin's Bay lying to the northward of the "middle ice," has a superficial area of less than eighty thousand (80,000) square miles. The Esquimaux inhabiting its shores are dependent upon its remaining open throughout the winter for their existence. A sudden or long continued closure would be the signal for their total destruction by starvation, for these improvident creatures have rarely reserved stores sufficient to last them during two weeks.

I will not hazard any opinion as to the mid-winter condition of the sea to the north of Rensselaer Harbor—in which direction the mist bank was seen; but we know, that one hundred miles in a due north line from it, there was an open sea in June, 1854, as shown by the well authenticated report of William Morton. The temperature of this sea as determined by Morton, and as recorded by his commander, was 36°; two degrees above the temperature of the air at the time of observation, and eight degrees above the freezing point of sea water. Another observation made in a different locality gave a temperature for the sea-water of 40°. This water came down from the north at the rate of from two to four knots. From the same quarter blew a strong gale of wind, and no ice was seen as far as the eye could reach at an elevation of from three to five hundred feet.

Where this warm water comes from is an important question, and one involving the whole system of Arctic currents, about which so little is positively known. That little, I have not the wish, even had I the ability, to use in any speculative hypothesis. There are members of this Association, who, by their devotion to science, have earned a claim to speak upon this topic, and in their able hands I leave it.

I cannot, however, wholly abandon the subject without citing a few observations, and calling attention to the striking tendency:

which seems to exist towards a great system of revolving currents. In the Greenland sea near Spitzbergen, the deep sea water is, according to Scoresby, warmer than the surface. A series of observations made by this distinguished navigator and philosopher, between the tenth meridian of western and the tenth of eastern longitude, and between the parallels 76° 16′ and 80°, show a constantly increasing temperature from the surface downward. The mean of nine observations with a mean latitude 77° 40′, gave a surface temperature 29·1° with extremes 28·1° and 30°, and at a mean depth of 665 feet the mean temperature was four degrees higher. A single observation taken in latitude 79° at the depth of 2,400 feet gave a temperature of 36°, at 4,380 feet the temperature was 37°, and at 4,556 feet in latitude 78° the temperature was 38°. Dr. Scoresby thought this deep warm water to be "a still further continuation of the Gulf Stream." Be this as it may, the current about the new Siberian islands is westward, and we have doubtless a continuation of this flow in the great Polar drift of the Greenland sea; another current sets south through the estuaries leading into and from Baffin's and Hudson's Bays.

That there are northward currents to keep the waters of the Polar Basin in equilibrium must be evident. In Baffin's Bay it is well known that the deeper ice bergs are carried northward, while the surface ice is drifting south, thus showing a deep sea current setting toward the Pole. The Behring Strait current runs in the same direction. The Gulf Stream after sending off a bifurcation to the southeast, stretches northward to the Norway coast, and is lost to observation beyond North Cape. The great Arctic water-sheds of Europe, Asia, and America, equaling together nearly five millions (5,000,000) of square miles, pour down their immense floods of warm water into the Arctic seas.

Speculate as we will, the facts in our possession show conclusively what was assumed in the outset, viz.: the existence of a cause constantly operating to keep the waters of the north Polar Basin elevated above freezing, and fully believing that this cause, aided by the influences of the superficial local action of winds, tides, and currents, is sufficient to produce a constant open sea in the neighborhood of the Pole, (that is, assuming the immediate vicinity of the Pole to be water,) I have great confidence that it can be successfully navigated. The route most practicable for accomplishing this purpose I believe to be through the great Polar estuary, separating the lands of America and Greenland, assuming severally the names, Davis' Strait, Baffin's Bay, Smith's Strait, and Kennedy Channel.

The direct efforts hitherto made for the purpose of reaching the North Pole have been confined to the Greenland sea. The

first attempts were made at the time of the origin of the famous Muscovy company, when the commercial nations of Western Europe held rivalry for the quickest passage to the Indies. Their efforts have been continued at intervals until our own time, and have uniformly resulted in failure as to the principal object.

Hudson is said to have penetrated in 1607 to latitude 82°, but the conflict between his nautical observations and his descriptions of land, make it doubtful whether he passed beyond 81°. The brave but unfortunate Barentz, and his companion, Corneliz Ryp, eleven years earlier had been driven back from the eightieth parallel; and Fotherby, a few years later, after repeated efforts, had no better success. Poole, in 1610, reached only to 79° 50′. The greatest latitute of Captain Phipps, in 1773, was 80° 48′; of Tschitskagoff, in 1776, 80° 30′; of Scoresby, in 1806, 81° 30′; of Buchan and Franklin, in 1818, 80° 32′; of Clavering, in 1823, 80° 20′. They were all arrested by the solid ice barrier near the meridian of Spitzbergen.

The closest approach to the Pole of which we have any well authenticated record, was made by the late Sir Edward Parry, to whose daring attempt I have already referred. This fearless navigator, abandoning his vessel, boldly pushed out upon the boundlesss ice-covered ocean, but was forced to retreat after reaching to 82° 45.

It would be highly important to determine with positive accuracy the progress in this direction of the early Dutch and English fishermen. Barrington declared that the ice barrier was not continuous from Greenland to Nova Zembla, but was broken on a movable meridian above Spitzbergen, allowing a free passage into the centre of the Arctic Ocean, which he maintained was an open sea, and had been frequently navigated. In two papers read before the Royal Society, in 1775, he cites twenty-six instances of navigators having reached to high north latitudes, and asserted, that a vessel had gone, even to the very Pole. But the testimony upon which these extraordinary reports is founded is extremely loose and unreliable, and subsequent writers have attached very little importance to them. Scoresby and Dr. Kane wholly discarded, and Barrow only partially accepted them. If true, these seas have since undergone remarkable changes in their physical aspects; and after a careful examination of the records of the more recent navigators, I am convinced, that the route to the North Pole, eastward of Greenland, is at this time neither practicable nor safe, and I believe that there is very little probability that that Pole of the earth will be reached wholly by water from any quarter. To effect this desirable object reliance must be placed upon *boats*, for the navigation of the circumpolar waters, and upon sledges for the transit of the boats over the investing

ice belt. The routes of Parry and Kane are both before us. As already stated, the advantages are greatly in favor of the latter.

I have already shown that the chief cause of the failure of Captain Parry was the southward drifting of the ice plain upon which he travelled. This difficulty is obviated by adopting the route through the channel to the westward of Greenland, for we have here the land masses of Washington and Grinnell, and the protruding tongue of western Greenland, which terminates in Cape Alexander, to check the equatorial drift of the ice as it breaks up early in the season. This route possesses, besides, other advantages equally important. The lands on both sides of Kennedy Channel have a nearly due north trend, continuing at least to latitude 82° 30′, affording a certain basis of operations upon the direct line of descent. They have a marginal belt of ice, at certain seasons, always smooth and secure, and they furnish a practicable field for travel, a secure foundation for depot stations, more secure than the treacherous outside ice, and a safe retreat for travelling parties if surprised at a distance from the land by a sudden disruption of the "floes."

A small vessel might be forced into Smith's Strait, and along the western shore, by working through the land leads, could reach, I have reason to believe from personal observations made in the spring of 1854, nearly to latitude 80°. Here the coast affords fine harbors for wintering. Upon the opening of spring, depot stations, or *caches*, could be established with dog sledges at different points along the land, and early in April a boat mounted upon runners might be started towards the open sea, which, enlarging with the advance of the season, would, I conjecture, be met between the 81st and 82d parallels by the middle of May. The distance thence to the Pole is not very great, and the navigable season continues for four months. I can see no insurmountable obstacle to complete success.

Gentlemen of the Association: If I may, without presumption, address myself directly to you, I would earnestly call your attention to this subject. It is brought before us, not in the days of Baffin and Hudson, nor in those of Parry and Franklin. It comes to us rich in the experience gained by more than three centuries of almost continuous effort, demanding of us to achieve the climax of discovery, to complete the effort so long and so bravely persisted in.

I have for some time been endeavoring to organize another expedition to those seas. After more than two years spent upon the route which I have recommended, I am convinced that if the experience of the past be properly used, the next attempt will in all human probability be successful, and that it can be accomplished with far less expense and danger than is popularly

supposed. A vessel of one hundred tons, equipped for two and a half years, and manned by twelve men, is all that is absolutely necessary. To this might, with advantage, be added a small steam tender, not exceeding thirty tons, fitted with a shifting screw. Under certain circumstances this little craft could be made available in the shoal water, close under the land, in the narrow shore leads of Smith's Strait.

At first this might seem inadequate to the service, and compared with the large force with which the English have latterly gone into the field is indeed small; but experience has shown that success in Arctic enterprise has not always been in proportion to magnitude of preparation. The brilliant triumphs of Davis, Frobisher, Baffin, Hudson, and others of the early navigators, were made with vessels varying from fifteen to fifty tons. The expedition should leave the United States early in April, and halting upon the Greenland coast to the south of Melville Bay, should procure at the different trading and missionary posts of the Danish government, and by the hunt, a supply of fresh meats and furs, and two good teams of Esquimaux dogs. This supply would greatly reduce the cost of the expedition, and would be in every way better than to carry all the stores from home. Large quantities of the flesh of the reindeer, water-fowl, and seal, could be obtained. The whalers annually capture great numbers of the Auk and Lumme (*Uria Alle* and *U. Brunnichii*) about Sanderson's Hope and Cape Shackleton, and at the Duck Islands they collect the eggs of the Eider fowl almost in boat loads. About Holsteinsborg and Egedesminde the reindeer (*Cervus Tarandus*) are quite numerous, their skins forming one of the staple articles of revenue from the colonies. Considerable quantities of their dried flesh (cured without salt) could be obtained of the natives and Danish officials. It was the original intention of Dr. Kane to have availed himself largely of these abundant stores, but he arrived too late upon the coast to admit of a halt without great risk of losing the chances of reaching his proposed ground of search before the close of the season. This delay was occasioned, as you are aware, by the unfortunate sickness which, during nearly a month, prevented his departure from New York.

The "Middle Ice" commences to break up about the first of June or late in May, and the passage into Smith's Strait could be effected by the first of August. Running up the coast of Grinnell Land, I should select a safe harbor at some eligible point as far north as the ice would admit, and there pass the winter. I have already expressed my belief in the practicability of reaching nearly to the 80th parallel, or at least I feel well assured, that the little Bight between Capes Frazer and Leidy, latitude 79° 42′,

can be attained. An examination of this Bay, with the ultimate view of one day being able to winter in it, was made by me in the spring of 1854. Before passing from this point I will call attention to some features of the physical geography of this channel, which have an important bearing upon the proposed operations, and which should govern the selection of a harbor. By a reference to the chart it will be seen that Smith's Strait runs diagonally to the general direction of the current coming down through Kennedy Channel, and in consequence, the Greenland shore will have the ice continually forced upon it by the pressure of the moving water; the same cause meanwhile freeing the opposite coast. That this side will afford greater facilities for reaching a high north latitude will be evident, and travelling parties would be protected against the chief difficulties which beset Dr. Kane in crossing the ridges of hummocked ice in the centre of the Strait.

It is on this western coast that the small steamer to which I have referred might be made serviceable, and in this opinion I am supported by the judgment of my friend, Mr. Wilson, late the sailing master of the "Advance." During a mild season the dissolution of the land margin of the ice fields is considerable, and a vessel of shallow draught propelled by steam, might possibly be able to work through Kennedy Channel into the Polar Sea. But this would be too doubtful a reliance for sole dependence. The main hope of success should be in the *boats*. Early in the spring, the shores of Grinnell Land should be—as already stated—lined with depots of provisions, as far north as latitude 82°, where a final *cache* should be established for the use of the polar boat party; these stores to be carried forward by the dogs. One of these animals will drag upon a sledge a weight of seventy (70) pounds thirty-two (32) miles per day, upon an average ration of thirteen (13) ounces of pemican—equal to about three pounds of dried meat—and two teams of seven each could readily carry forward ample stores for a full boat's crew of six persons. This crew should start their boat from the vessel in April. Within one hundred and fifty miles they would probably, as I have said, meet the open water by the middle of May or the first of June.

The chief difficulties which have hitherto beset Arctic travellers can be mainly overcome. The rough ice which baffled Dr. Kane's parties, as above observed, can be in a great measure avoided by avoiding the crossing of Smith's Strait; and Kennedy Channel having a due north trend, and presenting no salient capes like the remarkable projection of western Greenland, will, I have no doubt, be found mostly smooth. Such a track presents great facilities for travel. One man will readily walk sixteen (16) miles per day, dragging from one hundred (100) to one hundred

and twenty (120) pounds in weight. Dr. Rae conducted a party six hundred miles in twenty-two days, each of his men trailing after him, upon an Iroquois sledge, one hundred and ten (110) pounds. They carried a single blanket and change of clothing per man, but no tent, using for periodic rest the snow hut of the Esquimaux. These huts are readily constructed, and upon them I should place my sole reliance while upon the ice. Indeed, the amount of labor which can be performed by a skillful use of very simple means is truly astonishing; and in spite of the cold and poverty of the ice deserts, Kennedy, McClintock, Bellot, Sutherland, Pim, Osborne, Richards, and many others of the numerous corps of their gallant co-laborers have performed journeys which for extent would reflect honorably upon them as foot travellers in a more favored region.

The cold and scurvy are of much less serious moment than formerly. Experience has taught us many valuable lessons. By housing in the upper deck of the vessel, and using the porous snow as an external covering, the winters may be passed in health and comparative comfort, and even travelling may be performed during this season, if the parties are well supplied with heavy furs and sufficient quantities of carbonaceous food. The scurvy, hitherto often a great scourge to the crews of vessels wintering in the Arctic regions, can, with proper precaution, be resisted, and in this opinion I am sustained by the united testimony of the surgeons of Her Majesty's Arctic Squadron. The disease has been of very rare occurrence of late years, and wherever it has appeared, it has been owing to accidental causes, but chiefly from the long continued use of a salt meat diet—either in consequence of the parties never having been provided with any other standard supplies of food, or of their having so long remained in the field as to have consumed their fresh stores. Indeed, I am convinced that the climate is one of unusual healthfulness. The suffering from the disease among Dr. Kane's crew was mainly owing to the above mentioned cause. He started too early to profit fully by the discoveries which have been made in the art of preserving fresh meats and vegetables, and with the exception of a limited quantity of pemican—intended for use in the field—he had to depend upon the ordinary navy ration, without change or variation. Casual supplies of fresh food were obtained by the hunt or in barter with the natives, and when procured, invariably enabled his men to resist the disease, or, if developed, it acted as an immediate and specific cure. The difficulty experienced in keeping alive his dogs was chiefly owing to the absence of a diet suited to their necessities. The salt of the meat acted injuriously upon them, and the insufficient quantities which they could eat, did not enable them successfully to resist

the cold, and a strange epilepto-tetanoidal disease was in consequence developed among them. The same was observable among his crew, and doubtless for the same reason.

I have thus as briefly as possible given the reasons for believing in the existence of an open Polar Sea, and that through it the North Pole may be reached. Experience has reduced the scheme to a mere question of time. If not accomplished at this, it will be at no very distant day.

I have already announced to you my intention of laboring for the accomplishment of this object, and to this end I would respectfully solicit the counsel and sympathy of the Association. In this presence it would be useless to enumerate the results to science to be anticipated from its success. Some of them may, however, with propriety be briefly alluded to.

Under all circumstances, valuable additions would be made to our knowledge of Arctic climatology, and I should hope to determine something definite with regard to the condition, during the winter, of the waters beyond latitude 82°, and thus definitely settle the question, as to the *permanent* existence of the open Polar Sea, by passing a part of that season as far north upon the shores of Grinnell Land as possible. After entering winter harbor, and upon the earliest freezing, I should establish a depot of provisions in that direction, and with one companion and a team of dogs, would there pass the months of December, January, and February, in a *snow-house*. The land ice could be travelled during the moonlight period of each month, and observations made upon the situation and temperature of open water. Such a plan of operations is, under ordinary circumstances, quite practicable. That the months of September and October are available for the purpose of establishing provision depots, has been proven by my bold, daring, hardy co-laborer in the late expedition, Mr. Bonsall. That the winter may be passed in the manner above described, is shown by the experience of the enterprising and indefatigable chief factor, Rae, who, as you are aware, passed the winter, preceding his famous journey upon which he found the relics of Franklin's party, in *snow-huts* at Repulse Bay, and as he assures me, without any serious inconvenience from the cold, and without disease. To the experience of Dr. Rae I will add my own. During the autumn of 1854, while on duty connected with the safe retreat of the late expedition to the south, from Rensselaer Harbor, I passed in a similar manner with seven others of the ship's company the months of October, November, and part of December, and performed a return journey of three hundred miles, in eight days, with the dog sledges of the Esquimaux, guided only by the light of the moon and the stars. We lived during this period entirely without fire, for purposes of warmth, and but

for a want of food, could have passed the winter in safety. The temperature of the hut sank rarely to zero, and was often as high as the freezing point, being kept thus elevated by the heat radiated from the persons of the occupants.

I have already shown the importance of these northern lands as offering positions for observations upon the *human* and *floral* life of the region; and lying almost in a direct line between the two great magnetic centres, the great value of stations in the high latitudes of Grinnell Land for magnetic determination can hardly be overestimated. Our knowledge of the oceanic currents and tides of the extensive waters of the Polar Basin is enveloped in the same mystery which invests the regions of their birth and flow, and as the proposed line of descent runs midway between the seat of Atlantic and Pacific influences, it presents a most important field for the completion of the hydrographic survey of the northern hemisphere. Indeed, there is no department of physical science or natural history to which the expedition could not be made to contribute.

The collections of natural history made during the cruise of the "Advance," which were unfortunately abandoned with the vessel, exhibited a hitherto unknown feature in Greenland zoology—containing as they did, a number of skulls of the musk ox (*Ovibos moschatus*) found in almost every locality visited between latitudes 78° and 79°, by Dr. Kane, Mr. Goodfellow and other members of the party on the coast, and discovered by Mr. Wilson and myself near the base of the Great Glacier, about eighty miles eastward from Rensselaer Harbor, on the parallel 78° 40′. These animals seem to have become extinct on the continent of Greenland to the south of latitude 80°, but I have been assured by the Esquimaux that they still exist to the far north, and they speak of a large island in that direction upon which they live in great numbers.

The northern range of the *Cetaccea* is not known, and it would be highly important to determine whether they inhabit the extreme northern limit of our planet. I conjecture that their central *habitat* is about the Pole. Whales struck in the Greenland Sea near Spitzbergen have been caught to the southward of Behring Strait—recognized as the same animals by the harpoons remaining imbedded in their flesh—thus proving conclusively, that both from the Atlantic and Pacific oceans, they have free communication with the regions of extreme northness. These animals cannot live in an ice-covered sea. The once valuable fishing grounds of the Greenland Sea and Baffin's Bay are now almost unproductive, and the Right whale (*Balena Mysticetus*) is fast disappearing from the "northwest coast." It would be interesting to

determine whether they have been destroyed or driven within their ice-locked fortress. This last I think highly probable; and it would seem to be shown by a fact, stated by Dr. Kane in a paper read before the American Geographical and Statistical Society in December, 1852, upon "Access to An Open Polar Sea:" viz. that he observed the White Whale (*Delphinapterus Beluga*) passing up Wellington Channel, northward, through a broken sea of ice for four days in October. The Barbed Seal (*Phoca barbata*), was seen by Morton sporting in the waters of Kennedy Channel. These animals must have been denizens of the north, for since this species is not endowed with mechanical powers for opening breathing places in the ice, they could not have reached this water from the south, for this would have required them to pass underneath an unbroken belt of ice more than one hundred miles in width, which, I need hardly say, would be impossible. In its proper place I might have cited this fact, as well as the capturing by Morton and Hans of two Polar Bears (*Ursus maritimus*) near the same spot, as bearing strongly upon the existence of continual open water.

The lower forms of marine life have not been studied, and present a broad field for the investigations of the naturalist. Important problems are involved in the determination of their geographical distribution.

The Great Glacial system of Greenland has been subject to but little enlightened investigation. Giesecke thought this vast ice continent, as I shall venture to call it—which is the birth-place of the untold millions of tons of annual berg-discharge which come down from the north into the Atlantic—was a great congeries of islands, cemented together by ice. This continent, as it now appears, has a superficial area exceeding half a million of square miles, and it is the seat of constant atmospheric precipitation. The excess of this precipitation over evaporation—for evaporation, I may mention, takes place continually—and discharge by the river and icebergs, have an important bearing upon the physical geography and climatology of the region, and, indeed, of the whole northern hemisphere. Many of the geological phenomena of the ancient glacial period can at this time be witnessed almost everywhere on the Greenland coast.

The river system of Greenland—fed by the *Mer de Glace*—is greater than is generally supposed; large streams were discovered by Dr. Kane above latitude 78°. The great glacier of Humboldt, which bounds Smith's Strait to the northeast by a wall of ice sixty miles in length, and from fifty to five hundred feet in perpendicular altitude, is but a great frozen river—if I may so use the term—slowly flowing seaward, and discharging, piece by piece, its congealed fresh water into the salt sea, and

rafting millions of tons of detritus—boulders and sand—to more southern latitudes.

Upon all these points the portfolios of Dr. Kane will be found rich in material; and, when presented to the world it will, I am sure, give no cause to the distinguished Superintendent of the Coast Survey to regret the words of just and generous praise, which I had the gratification the other day, to hear bestowed by him upon this highly gifted man, for whose untimely death the world now mourns. But his facilities and opportunities were limited, and much remains to be accomplished.

I need not pursue the subject further, and have already detained the Association longer, perhaps, than the occasion warrants. The deep interest which I feel in a field of investigation, which has long engaged my attention, must serve as my apology.

Art. XXXVI.—*Review of Marcou's "Geology of North America."**

The volume on American Geology just published by Mr. Jules Marcou, demands more than a passing notice. Coming from a Professor in the Federal Polytechnic School of Switzerland, who is known to have traversed this country widely, and whose memoirs and American geological map form part of the publications of the Geological Society of France besides being distributed through several European journals, it is of interest to all to inquire into the character of the work and the reliability of the author's conclusions.

It will be remembered that former writings of the author on the same topic have been noticed in this Journal; and as he takes exceptions to the statements which have been made, it is the more incumbent on us to reconsider the subject with his later volume before us. We wish only to seek out the truth, that we may honor it, and here register it for the use of the science.

The work on the Geology of North America contains, (1) an account of the author's researches in America; (2) a general re-

* Geology of North America, with Two Reports on the Praries of Arkansas and Texas, the Rocky Mountains of New Mexico, and the Sierra Nevada of California, originally made for the United States Government by Jules Marcou, Professor of Geology in the Federal Polytechnic School of Switzerland, formerly United States Geologist, etc. 144 pp., 4to., with three maps and seven plates. Zurich, 1858.

With regard to the title of "United States Geologist," we remark for the enlightenment of foreign readers, that there is no such office under the Government, and no national Geological Corps. When an expedition for exploration and survey is organizing, some person is usually associated with the party for scientific research, by appointment from the Department in charge of the survey. Those selected are sometimes good geologists and sometimes otherwise.

view of the geology of the continent with reference to the geological map; (3) a classification of the mountains of part of North America; (4) a review of his reviewers; (5) a history of the progress of American geology. The question important to geologists—to European more than American—is, whether American geology is correctly represented.

I. History of Geology.—Mr. Marcou commences by republishing the observations of Maclure on the Geology of the United States with the accompanying map, from Vol. VI. of the Transactions of the American Philosophical Society, doing full justice to this earliest of American explorers. He reviews the labors of many who have followed him, making honorable mention, as he should, of Vanuxem, one of the ablest of our geologists, of Hitchcock, Owen, and others. But we are sorry to see imperfections in the history, which evince that personal disappointments have warped the author's judgment. Professor Hall's connection with American palæontology is well known to the world. Mr. Marcou, enumerating in a paragraph the cultivators of palæontology in America, mentions "Lesueur, Harlan, Jefferson, Say, Green, Bigsby, Rafinesque, Troost, Morton, Redfield, Lea, and Hitchcock;" then, Conrad and Leidy, as taking the lead of all, the "best palæontologists in the United States," and ends with what he calls "the young palæontologists of the present day," "Dr. Shumard, Holmes, Newberry, Meek, Wyman, Billings, etc."; Hall's name is not included. He has honored him, however, with a separate paragraph, in which he speaks of the "Palæontology of the State of New York by James Hall," as "a very useful work;" and then closes a disparaging sentence with, "the best part of it being the plates drawn by Mrs. Hall, and also the geological order." Conrad and Leidy are highly appreciated. But in his treatment of others, the author shows that he has himself been reviewed. This is apparent also in the closing sentence of this brief History of American Geology. "Maclure, Vanuxem, Hitchcock, Taylor, Conrad, Emmons, Lyell, de Verneuil, and David Dale Owen, are the *only discoverers*; other geologists have extended and detailed the just views and grand ideas that these illustrious savants were the first to divulge:"—an association of names that will surprise, by its omissions if not otherwise, those who know much of science in America and little of the influences that have operated upon the author of this history. Mr. Marcou shows again that he has had reviewers, in the remark that he makes about "the half dozen hieroglyphical pamphlets" published as the Geological Report of Progress of the Canada Survey. He evinces that his American conclusions have met with opposition, also, by his slight of Foster and Whitney's in-

vestigations in northern Michigan, and of the various researches of the Professors Rogers, and by his studied neglect of others.*

There are also imperfections in the History arising from a partial acquaintance with the subject and the science. Thus he speaks of Mr. E. James as having been the first to recognize the "New Red Sandstone" on the slopes of the Rocky Mountains, when all he had any knowledge of was *a red sandstone*. He speaks of the knowledge of the geographical extension of the "New Red" being due to Dr. D. Houghton and others for Lake Superior, when no evidence of its existence in the Lake Superior region is yet known or was ever detected. He speaks of the discovery of the "Old Red" by Taylor, when the so-called "Old Red" is only the upper part of the American Devonian.

Without further specifications, it is plain that in this history the author has neither dealt fairly with others or the subject.

II. Review of the Reviewers.—We refer to this chapter merely to add, that the personal feeling above attributed to the author, is here acknowledged. We are very sure, that only the belief that Mr. Marcou was propagating in his publications erroneous views abroad, led to the notices of his memoirs and former map that have so chafed him. On no other ground than a desire to promote the interests of science have the pages of this Journal been open to the criticisms.

III. Mountain Systems.—The author describes the mountain systems of North America and their ages, as he supposes they must be according to the theoretical views of Elie de Beaumont. A determination of the age and relations of each by means of observed facts would be positive knowledge and of some service to the science.

IV. Researches.—The points in the explorations of the author which give his work special prominence, are the assumed identification—

(1.) of Triassic rocks in the Lake Superior region;

(2.) of the Permian Formation over the slopes of the Rocky Mountains;

(3.) of Triassic rocks in the same Rocky Mountain regions;

(4.) of Jurassic rocks, in the same region.

We should take pleasure in claiming for the author the establishment of either one or all these points, if we could justly

* Mr. Marcou says, with characteristic self-complacency, and with evident irritation because others do not call "New Red," what he does: "The brothers Rogers and James Hall try their best to suppress the New Red Sandstone formation in America," &c.; and after making various absurd statements and suggestions, bringing in Logan for a share of his attempted ridicule, he adds respecting them, "I would advise these honorable savants to consider if one of these determinations would not be preferable."

do it. The progress of American geology is largely due to foreign geologists—to Lyell of England, and De Verneuil of France; and they are honored for their labors. They were wise men; appreciating geological evidence, they used it cautiously and surely, and made each step a step of real progress. They did not conclude, when they came across *a* red sandstone, that it was *the* "New Red" or *the* "Old Red;" or on the discovery of a *magnesian* limestone, that it was *the* magnesian limestone of the Permian. They knew, with all other geologists, that mere color and mineral characters were the very worst test of equivalency between the rocks of the two continents; that the test will not answer even for the United States alone; that an appeal to such characters in this period of geological science betrays great want of experience. They came to the country expressly to subject all such considerations to the higher test of organic remains, and in this their great merit consists. Mr. Marcou, we regret to see, has taken the course which they rejected and which science long since repudiated. It is true the region he examined was nearly destitute of fossils. But there was so much the more reason for doubting, as all others had done before him.

1. *Triassic Rocks in the Lake Superior Region.*

The only evidence that these rocks are Triassic, given by the author, is of the superficial kind just referred to. He has not claimed to find a fossil in the beds or any proof that decides the question. He remarks that Dr. Jackson "confirmed the justice" of the view by finding beds with *Pentamerus oblongus*, an Upper Silurian fossil, on Keweenaw Bay. But it is known that the strata of Keweenaw Point overlie the red sandstone; and Hall has shown them to be Lower Silurian from the fossils collected there by Foster and Whitney. (See F. and W.'s Report, Part I, p. 118.) Even if the red sandstone were above the Silurian, this would not make it Triassic, according to any known rule of geological reasoning.

The similarity of the beds and the associated trap to the Connecticut River rocks, led early to the *supposition* that both might be of the same age, but it was no basis for such knowledge as Mr. Marcou claims. Foster, Whitney, Hall, Logan, and others, have been over the same ground, and argue from the fossils and superposition that the rocks are as old as the Potsdam Sandstone. And yet Mr. Marcou still maintains, against all the investigations more recent than his own, and on evidence which geologists know to be worthless, that the rocks are *Triassic*. Mr. Marcou states that these geologists hold the *old* opinion, when on the contrary his view is the old one, and the only one current until the evidence became known which these geologists themselves brought forward.

2. *Permian Rocks in the Rocky Mountains.*

In the "Itinéraire Géologique du Fort Smith et Napoléon, (Arkansas) au Rio Colorado de Californie," in 1853,* Mr. Marcou states, in his notes for Dec. 22, after describing what he calls the *New Red Sandstone* of the region, "Puis on a au-dessous un calcaire magnésien ou dolomitique épais à stratification régulière de ½ à un pied d'épaisseur, plongeant au nord sous un angle de 10 à 15°, en stratification concordante avec le *New Red*, et quelques assises du *magnesian limestone* alternant avec le grés rouge à la base. Dans ce *magnesian* on a une couche avec fossiles trés-mal conservés; je crois reconnaître des fragments de *Belemnite?* un *Nautilus?* un *Pteroceras?* Quatre milles après avoir marché sur ce *magnesian* on a la lave du volcan qui la recouvre; et nons campons sur la base, non loin des cones secondaires du grand volcan. Pas de diluvium. And the "Résumé" by himself, published in the same volume, says respecting these observations: "Shortly after quitting the Colorado Chiquito we found here, with the last beds of the red clay of the Trias and in concordant stratification, a magnesian or dolomitic limestone, with very regular strata from half a foot to one foot in thickness. Several beds contain fossils badly preserved; among which I recognised, however, a *Nautilus*, a *Pteroceras*, and a *Belemnites*. This formation, which is placed between the Carboniferous and the Trias, corresponds, without doubt, to the magnesian limestone of England, and is a new member which I add to the series of secondary rocks in North America. "This magnesian limestone has only four miles of extent in the place where we crossed it, and disappears beneath lava and volcanic ashes. I have observed it farther to the west, and it appears also to occupy eastward one of the lesser chains of the Sierra de Mogoyon."

In the new work, this paragraph remains the same, except that in the place of "a Pteroceras, a Belemnites," it reads "a Gasteropoda, and perhaps a Belemnites;" and after the words magnesian limestone, in the line before the last, "(*Permian*)" is inserted.

When the discovery of Permian fossils west of the Mississippi was announced, a few months since, before the Geological Society of France, Mr. d'Archiac put forward Marcou's claim to the first discovery of the Permian in the Rocky Mountains, basing it upon this very observation, stating that this *magnesian limestone* was compared by him with the magnesian limestone of England, but that the fossils were too imperfect for determination.†

Here then, although the Permian magnesian limestone of one part of England is not represented by a similar limestone in all

* Published in the Pacific Railroad Reports, vol. iii.

† See this Journal, this volume, p. 260.

other Permian regions of Britain, nor in a great part of the Permian region on the Rhine and in Russia; although Murchison says, "In the exploration of Russia, geologists were taught by the diversified Permian group not to dwell on the local mineral distinctions of central or western Europe, but to look to the wide spread of certain fossil remains, which, in vastly distant countries, occupy the same horizon;" although in North America, magnesian limestones are known of all ages, of the Potsdam, Trenton, Upper Silurian, Devonian, and Carboniferous eras; and although it is very common in all formations that limestones are equivalents, even on the same continent, of sandstones and shales; yet we have the decision that *a magnesian* limestone in the Rocky Mountains, lying beneath what is regarded as the "New Red Sandstone," is the equivalent of *the* magnesian limestone of England. This certainly cannot be regarded as a safe deduction from geological evidence. The fossils were too imperfect to be identified. Yet among them, "a *Nautilus*, a *Pteroceras* and a *Belemnite*" were recognized; or as stated in his new work "a *Nautilus*, a *Gasteropoda*, [he meant to say *Gasteropod*, the singular number], and perhaps a Belemnite." Now "a Nautilus" proves nothing as to its being *the* magnesian limestone; "a Pteroceras" is direct testimony against it; and "a Belemnite"? according to all authors, affords the idea no more encouragement. "A Nautilus, a Gasteropod, and a Belemnite?" prove this magnesian limestone to be Cretaceous, or Jurassic, and not older than Jurassic, if the evidence may be used at all. The cautious geologist would have certainly doubted his "New Red" or Triassic, if he found it overlying beds containing what was probably a Belemnite. The evidence, if worth anything, abolishes both the Triassic and Permian together.*

We conclude, therefore, that credit cannot be claimed by or for the author, with regard to the discovery of the Permian in the Rocky Mountains.

3. *Triassic Formation in the Rocky Mountains.*

Mr. Marcou observes that "this formation, which I was the first to notice and recognize in the West, (see *A Geological Map of the United States and the British Provinces of North America;*

* This attempt at the identification of Permian beds in the Rocky Mountains, is in strong contrast with the method of research of Professor Emmons in North Carolina. Prof. Emmons's discovery in that State of Thecodont Saurians, the same group of Reptiles that characterizes the Permian in Europe, constitutes a strong argument in behalf of the existence there of this formation. And if a full survey of all the fossils, both of plants and animals, and a comparison with those of Europe, lead to a modification of the view, it is no discredit to him. He has the honor of aiding in bringing about the comparison and helping on towards the final result. Mr. Marcou's dashing style of work is equally in contrast with the mode of investigation which has at last resulted in detecting Permian strata west of the Mississippi.

Boston, 1853, p. 42,) attains a very considerable development, and according to my observations has a thickness of four or five thousand feet." Three divisions are made out by him, (1) the lower, the equivalent of the *Bunter Sandstein;* (2) the middle, of the *Muschelkalk;* (3) the upper, of the *Variegated Marls* or *Keuper.* Here, then, we have not only the Trias identified, but even its European subdivisions—though with an acknowledgment that the divisions are not "very certain." We think it was a risky conjecture, for he found no fossils whatever to sustain the division into *Keuper*, *Muschelkalk* and *Bunter Sandstein.* This off-hand settling of a problem that requires great care even among the fossiliferous beds of Europe, was a bold exploit in geological gymnastics.

But as to the great Triassic formation itself, the only palæontological evidence is from a specimen of fossil wood, met with in latitude 35° 42′ 32″ N., and longitude 99° 36′ 10″ W., "a full grown tree with branches, very much resembling the *Pinites Fleurotii* of Dr. Mougeot which is found in the New Red Sandstone of the Val d'Ajol in the Vosges;" after which he adds, "and this establishes a connection between the *New Red* of France and that of America." Thus one single fossil—that one, a species of Pine, and only "very much resembling the *Pinites Fleurotii* of Dr. Mougeot," *establishes.* This is a very strong word for a geologist to use on evidence so small and so uncertain, with the fate of four or five thousand feet of rock at stake, and with the beds next beneath containing "perhaps Belemnites." The prudent observer would have said, "establishes nothing;" and such is the fact. The gypsum, the marls, red color, and other such characteristics are also mentioned to sustain the parallelism. But it is now well known that gypsum, marls, and red color occur both in the Cretaceous and Permian of the west, well illustrating the remark, that such proofs are worse than useless: they have always been a fertile source of error; they might have warranted a bare suggestion but not more, and as far as suggestion goes, that of James had long the precedence.

On *such* evidence, a region over the Rocky Mountains which is one thousand miles from north to south and eight hundred miles from east to west, is for the most part colored on the map as Triassic, or "Terrain du Nouveau Gres Rouge." Such a region—1000 miles by 800—would take in quite a respectable part of the continent of Europe.

The Triassic will probably be identified over the Rocky Mountain Region. But this going ahead of discovery shows more eagerness than good judgment or science.

4. *Jurassic Rocks in the Rocky Mountains.*

The strata referred by the author to the Jurassic age were observed by him over the Llano Estacado and other regions in the

vicinity. The identification in the case of these beds rests upon organic remains, as it ought; yet there is the same faith in mineral coincidences that has before been pointed out. The species mentioned are the *Gryphea dilatata* var. *Tucumcarii*, an Ostrea very near *Ostrea Marshii*, a *Trigonia* and a species of *Astarte;* but the identification rests mainly upon the *Ostrea* and *Gryphea,* which are figured on plate 4. Great importance, therefore, attaches to the right determination of these species; for if not Jurassic, if associated in other strata in the west with well known Cretaceous species, they serve as credentials for the Cretaceous instead of the Jurassic.

The bearing of the evidence from these fossils has been discussed in this Journal by Wm. P. Blake,* who has pronounced them Cretaceous; and this conclusion was previously arrived at by Professor Hall. But these persons are among the reviewers whom the author discredits, and we have consulted another able palæontologist, highly commended by Mr. Marcou. The following are the views on the subject, which he has furnished us:

"The species which Mr. Marcou refers to *Gryphea dilatata* Sowerby, is the true typical form of the Cretaceous species, *Gryphea Pitcheri* of Morton, as is shown by Conrad in the Mexican Boundary Report, vol. i, p. 155, pl. vii, fig. 3 and pl. x, fig. 2; see also Professor Hall, in the Pacific Railroad Reports, vol. iii, plate 2, figs. 1 to 6; and Dr. B. F. Shumard in Marcy's Report on the Exploration of the Red River, plate 6, p. 205. As it is known to range through a considerable thickness of rocks in the Southwest, containing numerous well-known Cretaceous fossils, (on which Dr. G. Shumard in the Transactions of the St. Louis Academy of Sciences, vol. i, p. 289, may also be consulted), we may safely conclude that it is distinct from Sowerby's Jurassic species. A glance at Morton's figure (Synopsis Organic Remains, plate 15, fig. 9), drawn from the original specimen from Arkansas, will satisfy any one of its identity in species with Mr. Marcou's figure, (plate 4, fig. 2).

"The Oyster figured on the same plate as the *O. Marshii* Sowerby, is the shell described by Dr. B. F. Shumard in Captain Marcy's Red River Report, (page 205, and fig. 2, plate 5,) under the name of *Ostrea subovata.* It occurs in the Cretaceous at Fort Washita, along with *Ammonites vespertinus* Morton, *Gryphea Pitcheri* Morton, (G. dilatata of Marcou), and species of *Exogyra, Pecten, Astarte,* etc. Both of these species, the *Ostrea* and *Gryphea*, were found extensively through the Cretaceous formation west of the Mississippi by Dr. G. Shumard."

According, therefore, to the best recent authorities, the fossils supposed to be Jurassic are really Cretaceous, and no evidence of Jurassic rocks in the great west is published as such by Mr.

* This Journal, [2], xxii, 383, 1856.

Marcou. This is bad luck for the Jurassic, Triassic and Permian of the Rocky Mountains, on which his claims to a place among the "discoverers" rests. His results, reduced to the simple facts ascertained, amount only to this—that the geology of the Rocky Mountain Region includes Cretaceous and Carboniferous rocks—a fact that was quite well known before.

Whoever then may identify true Permian, true Triassic, or true Jurassic strata, beyond the Mississippi, will not have borrowed from Mr. Marcou, and can owe him no credit.

But the subject is not one of mere credit to any person; for it is unfortunate in its bearing on the progress of geological science to have false views about some 500,000 square miles of territory, and much more besides, spread widely abroad through reputable Journals, and Transactions of distinguished European Societies.

We might here leave the author's researches. A few other topics, however, may have a brief word. And while criticising his labors, we would say that his work contains many observations that are better than his inferences.

We cite, at first, from our excellent palæontologist again respecting some Cretaceous and Carboniferous fossils. "The large *Gryphea* or *Exogyra* (plate 3, fig. 1) referred to *G. sinuata* of Sowerby, I am strongly inclined to believe is *E. ponderosa* of Rœmer, (Kreide von Texas, plate 9, fig. 2), which is only a variety of *E. costata* Say, as has been shown by Conrad in the Mexican Boundary Report, page 154, plate 9, fig. 1. The figure given by Rœmer represents a small individual, but he mentions that it grows to a great size. The only difference between *E. ponderosa* and *E. costata*, is that the latter is generally marked by distinct radiating costæ, while the former has none, or is but very obscurely marked in this way. There is, however, every intermediate gradation in this respect, between the two varieties. Both varieties occur in New Jersey, Alabama, and Tennessee, as well as in the Southwest. Sometimes the var. *ponderosa* attains a very large size, and it is not unfrequently from two to three inches in thickness."

"The *Gryphea Pitcheri* of Marcou (plate 5) has well marked differences from his *Gryphea dilatata* (the true *G. Pitcheri* of Morton). In referring the shell to *G. Pitcheri*, he follows Rœmer, who also fell into the same error, (Kreide von Texas, p. 75, plate 9, fig. 1). These differences are seen in the figures. Compare figure 5, plate 4, with that of his *G. dilatata* and Morton's figure of the true *G. Pitcheri:* the beak of the latter is truncated while that of the former is angular and laterally curved. This peculiar form has been noticed by Conrad (Boundary Survey Report, vol. i, plate 9, fig. 2 *a b*) as a variety of *G. Pitcheri* and designated *G. Pitcheri* var. *navia* (see also Hall, Pacific Railroad Re-

ports, vol. iii, p. 100). I feel convinced that it is distinct from the true *G. Pitcheri* of Morton, (Marcou's *G. dilatata*)."

"The shell figured on plate 7, fig. 3, as *Spirifer striatus*, is the *S. cameratus* of Morton, (Amer. Jour. Sci., xxix, 1836, p. 150, plate 2, fig. 3,) as has been determined by Prof. Hall. Rœmer described it under the name of *S. Meusebachanus* (Kreide von Texas, p. 88, plate xi, fig. 7), and in Stansbury's Report (Expedition to the Great Salt Lake) it is named *Sp. triplicatus* by Hall. Owen referred it to *Sp. fasciger* Eichwald. It is very common in the west, ranging from Ohio to the Rocky Mountains, and from Nebraska to New Mexico; Mr. Hayden found it in the Black Hills. It is known to range up nearly to the base of the Permian in Kansas; but I have no knowledge of its having ever been found in *Lower* Carboniferous rocks. Figure 2 on the same plate also referred to *S. striatus*, I am inclined to believe is not that species; some four or five American species appear to have been confounded by different authors under that name. There are many other American Carboniferous species set down as identical by Mr. Marcou and others, but it is well known to American palæontologists that the whole subject requires careful revision."

"Mr. Marcou, on page 67, in a note, mentions that fossils from Vancouver's Island, have been determined as Cretaceous by F. B. Meek; but he thinks the determination an error, and that they are Jurassic. In the paper referred to (Trans. Albany Institute, vol. iv, p. 37), Mr. Meek speaks of the fossils placed in his hands by Dr. Newberry as belonging apparently to two rocks. Part of them he pronounced decidedly as Cretaceous—among them a *Baculite*, which is not distinguishable from *B. ovatus*. As regards the rest, which were the larger part, he gave no decided opinion. Subsequently, (but before the publication of Mr. Marcou's work,) he mentioned to Dr. Newberry that the latter were probably Jurassic, and so it is stated by Dr. Newberry in the Pacific Railroad Report, vol. vi, p. 66."

On page 64, Mr. Marcou speaks of the *Coal Measures* at Umpqua in Southern Oregon, where they are not known. He has overlooked the Eocene Tertiary of California. He makes the strata in California, from which Dr. Trask describes Baculites and Ammonites, Jurassic, when they are obviously Cretaceous. But it is not necessary to enter into further details.

V. Geological Map.—This map is open to most of the objections noticed in the former reviews in this Journal,* and we need not repeat. With regard to the region beyond the Mississippi, we refer again to the palæontologist whose opinions we have cited, as he is well acquainted with that part of the continent. He

* Volume xvii, p. 199, 1854, and xxii, p. 383.

observes respecting the great yellow (Triassic) area on the map, of more than 500,000 square miles: "We now know beyond any reasonable doubt that all the country from the Platte to the British Possessions, and from the Missouri to the Black Hills is occupied by Cretaceous and Tertiary rocks. And as regards the region from the Platte southward to the Red River, very far the larger part is known to be *not* Triassic, while it is possible that the Trias may occur in some parts of it."

"The surface formations of the Llano Estacado, instead of being Jurassic, are Cretaceous; this is plain from the section of Pyramid Mountain, and also from numerous other facts collected by recent explorers. If the Jurassic rocks exist there, which I am inclined to believe is the case, they are, as at the Black Hills, an *underlying* and not an overlying rock." Again, "over the region, north of the Llano Estacado which on the map is colored as Jurassic, the Cretaceous and Tertiary probably extend; but the Jurassic may be looked for over a narrow outcropping belt along the east side of the crest of the mountains." These observations are by one who has facts as a basis for his conclusions, and who admits a doubt until it is fully removed by investigation.

In conclusion, we would say that our reconsideration of the labors of Mr. Marcou in America has not raised our estimate of their value. We know well that if any American geologist had mapped out strata and synchronized those of America and Europe on such data as have satisfied the author of the "Geology of North America," he would have been deemed young in the science, with much yet to learn before he could have a sober hearing. We cannot, therefore, think that his former reviewers and opponents deserve, because they differ from him, either to have their names expunged from American geological history, or thrown into discredit; nor do we believe that their reputations will seriously suffer from the judgment of our ambitious Rocky Mountain explorer. Finally, our readers must be fully persuaded, that "Marcou's Geology of North America," is not "good authority,"—except with regard to the author and his style of work.

J. D. Dana.

ART. XXXVII.—*On the Tidal Currents of New York Bay, near Sandy Hook;* by A. D. BACHE, Superintendent United States Coast Survey.

(Communicated by authority of the Treasury Department.)

IN a former notice of the observations of tidal currents near Sandy Hook, I stated the general character of the results obtained, and their specific bearing upon the explanation of the growth of Sandy Hook, and of the changes above and below water in its vicinity. I propose now to describe more in detail the observations themselves, to discuss numerically and by the aid of diagrams the results obtained, and to show from them how the Hook is built up, the False Hook channel deepened, and Sandy Hook Bay modified in its shore line, and especially in the configuration of the bottom. Sketch No. 1 shows the current stations occupied on the outside of the Hook, and in False Hook channel and the approaches, in the different parts of the Main Ship channel and its approaches, and in the eastern, middle, and western portions of Sandy Hook Bay.

It will be convenient to discuss the subject under the three divisions already referred to of (1) the normal currents in the main ship channel and its approaches, of (2) the currents of False Hook channel and the approaches, and (3), the currents of Sandy Hook Bay.

1. *Normal Currents at the Entrance to New York Bay.*

Diagram 1, (sketch 1) shows the comparison of the average tidal currents at three groups of stations, the most eastern, comprehending the positions R_2 R, Q and H, shows the currents at and within the bar in the vicinity of Gedney's channel; the middle, embracing the stations P, O, I, A_2, A_1, lying for the most part between the eastern portions of Flynn's Knoll and the point of Sandy Hook, shows the currents of this part of the main ship channel; while the western group B and B_2 gives the currents for the western part of the main ship channel in the vicinity of the South West Spit. Diagram 1 (sketch 1) also exhibits the type form of the tide wave as observed at Sandy Hook. The currents are plotted for flood and ebb, above and below a common axis, which corresponds to the mean level of the sea. These curves are plotted in their true relative positions to the tide wave as regards their epochs.

Table 1 contains the *dates*, *names of stations*, *localities*, *luni-current intervals*, *durations*, *intervals after the tide wave*, *velocities and directions* of the currents. In this table are given the numerical results from all the stations to which we have referred, reduced to their

mean values. In table 2 the averages for the groups are given. From the first line of table 2 we find that about 56^m after the time of high water at Sandy Hook, the ebb current begins to make in the locality covered by the eastern group of stations, running east by south, reaching its greatest rate of about 1·71 miles per hour, (in about three hours), and then decreasing (in about three hours) to zero, and turning to flood at about 1^h 33^m after the time of low water, the ebb thus being estimated at 6^h 19^m.

The flood reaches its maximum in about 3^h, when its rate is 1·11 miles per hour, running generally northwest for about 5^h 43^m, and reaching slack water at about 56^m after the time of high water at Sandy Hook. The times of running ebb and flood are nearly equal. The greatest rates are as 17 to 11, and the average as 10 to 6.

Line 2 of table 2 gives the results from the middle group of stations, from which it appears, that in that portion of the main ship channel lying north of Sandy Hook, the ebb currents run generally east by south, the flood west by north. The ebb has a less velocity, and the flood a greater, than for the eastern group. The maximum velocity of ebb is 1·47 miles per hour, and of flood 1·68 miles. The mean velocities of ebb 1·09 and of flood 1·04 miles. The reason of this change of proportion between the maximum and mean velocities of the ebb and flood currents, is obvious from an inspection of the type curve. It will be seen that the ebb is characterized by a uniformity of rate during the second, third, and fourth hours of its existence, while the curve for the flood resembles the curve of sines. The ebb current turns earlier, lagging but 22^m after low water, thus turning more than 30^m before the corresponding currents to the eastward.

The 3d line of table 2 shows the results for the western group, in the vicinity of South West Spit. Here the currents have a course round the compass, are much less rapid than the others, and are earlier.

It would be curious to know where the earliest turning of the current is to be found, and, indeed, these results open up many questions in regard to the whole Bar and the channels through it. For our present purpose we have limited ourselves to obtaining the means of comparison of the normal currents sweeping by the point of Sandy Hook with those secondary ones which we shall next proceed to trace.

2. *False Hook Channel and the Approaches.*

The current stations S, T, C, D, G, F, and V, (see sketch 1), show the movements of the water in this channel and its vicinity, while stations at E, and "off Long Branch" lie quite to the southward. S, shows the action at the northern entrance, and V at the

southern, C in mid-channel. T at the entrance is influenced by the shoals of the False Hook. G, F, and V, between the ocean and False Hook channel are unsatisfactory. D shows the shore currents of Sandy Hook. The results from these stations are given in table 3, which is constructed in a manner similar to table 1, already described. Treating S, T, C, F, and G together as a group, we have for the luni-current interval $8^h\ 20^m$ or 58^m after the time of high water at Sandy Hook for the commencement of ebb, the current of ebb beginning earliest at S, G, T, the flood first at F, S, T. The interval of ebb is about the same as that of the vicinity of Gedney's channel, the flood three quarters of an hour earlier. This gives above a half hour for the difference of duration between the main ebb and flood, and the corresponding ones of this part of the approach to New York Bay.

The mean epochs (table 4) are $8^h\ 14^m$ and $14^h\ 02^m$, being 17^m and 46^m less than those found for the vicinity of Gedney's channel. The flood exceeds the ebb about 24^m, whereas for the stations near Gedney's channel the ebb exceeds the flood by about 34^m, and in the south channel the ebb has greatly the advantage both in duration and velocity. This shows the influence of the secondary or draught currents through the False Hook channel. The average maximum velocity at these stations of both flood and ebb is 1·41 miles, which last in the vicinity of Gedney's channel was 1·71 miles. The mean maximum velocity of the ebb is but 0·91 miles, which was 1·03 miles for the stations near Gedney's channel, and about the same at station S. The ebb makes out but slowly through the False Hook channel, the maximum velocity of the flood at C is 1·62 miles, and of the ebb but 0·78, and the means 1·02 and 0·50 miles per hour. The time during which the ebb runs is $5^h\ 41^m$, and the flood $7^h\ 08^m$, a difference of $1^h\ 27^m$, and this in the axis of the stream. As the scouring action of these currents may be regarded as varying with the product of the square of the mean velocity and the duration, we have for station C the ratio of about 1 to 5 for the relative work of ebb and flood. At the edge of the False Hook Shoal the duration of the ebb appears to be even less, there being but $5^h\ 20^m$ of ebb. The currents at C are plotted with the tide wave on diagram 3, (sketch 2). It appears that the curve representing the flood drift approaches the type form, while the ebb is anomalous —it is weak and inconstant. We are now prepared to find the shore currents such as the observations prove them to be. The results at station D, off the wreck of the brig Commerce, are shown in diagram 4, (sketch 2), where they are compared with the tide wave of July 18th. The flood runs for $7^h\ 15^m$ out of $12^h\ 42^m$. The greatest velocity of the flood is 1·23 miles against 0·62 of the ebb. The directions are nearly opposite. The cur-

rents "off Long Branch," off Ocean House, at station D, and at station 9, near point of Sandy Hook, are shown on diagrams 4 and 5, (sketch 2). The ebb currents are quite feeble in both. It is the shore current just discussed which transports materials to the end of Sandy Hook; it is the grand current, in fact, which makes the False Hook channel, and the False Hook occupies the debateable ground between the outside and False Hook channel currents at certain times of tide, and is built up by the slackening ebb. In this point of view the shoal tends to restore equilibrium. The difference of action of flood and ebb is defined by this shoal. At station V on the southern extremity of the outer middle ground, and in close proximity to the lower entrance of False Hook channel, the currents are feeble, and an equilibrium of ebb and flood drifts seems to be established. It would appear that the scouring action of the tidal currents is insufficient to keep the bar of this channel open.

It is the material carried along the outer shore of Sandy Hook, and deposited at the point, which chiefly causes the growth of the Hook. Whenever it shall be considered desirable to limit this increase it will be easy to do so, by a series of jetties so placed as to arrest the movement of the sand to the northward, successive structures stopping the material which may pass round the point of the more southwardly jetties.

3. *Currents of Sandy Hook Bay.*

To obtain a clear idea of the tidal currents of Sandy Hook Bay, let us suppose it divided into three sections, eastern, middle, and western, and ascertain the relations of direction at successive periods. To this end we arrange the results according to the twelve tidal hours, calling the epoch of low water 0^h, the epoch of high water 6^h, &c.

The flood current commences in the main ship channel and in Sandy Hook Bay at nearly the same period, viz., about $1^h\ 04^m$ after the time of low water. The water of the main ship channel now flows to the westward, that of the eastern section of the Bay to the southward, that of the middle to the southwest, and that of the western section to the west. This general condition continues for about two and a half hours, and is exhibited upon diagram 1, (sketch 3). It will be noticed upon this diagram, that a limited region about the point of Sandy Hook is subject to a counter drift or whirl. This whirl is increasing in size, and its axis is moving southward; its existence is due to the lateral draught produced by the strong and steady stream of the ship channel, to which we shall refer hereafter. At 3^h the effect of this lateral draught on the eastern section is already seen in the slacking up of the currents, and at 4^h it has completely reversed the direction of the drifts. At this period, 4^h, the conditions are

exhibited by diagram 2, (sketch 3). The currents are northward, (with velocities of 1·4 and 0·3 miles per hour, at stations near to and more remote from the main ship channel), in the eastern, southwestwardly (with velocity 0·3) in the middle; and westwardly (with velocity 0·4) in the western section of the Bay, while the current of the main ship channel now at its maximum, holds a course due west, with a velocity of 1·9 miles per hour. Later still, we find this whirl, heretofore elliptical, assuming a more circular form. At 5^h it has extended to the middle section of the Bay, reversing the currents of that region, (see diagram 3, sketch 3). Its axis still moves to the southward, and at 6^h there occurs a space of slack water, near the point of Sandy Hook, where we at first noticed the existence of the whirl that we have followed. The currents are now diminishing rapidly in the main ship channel, as well as in the western section of the Bay, and at 7^h we find the ebb current prevailing. At first the course of the ebb currents of Sandy Hook Bay may be represented by straight lines converging to a point, in the ship channel north of Sandy Hook, but these lines of direction gradually curve to the southward, until as in diagram 4, (sketch 3), (which represents the conditions at the 9th hour) the waters of Raritan Bay press into Sandy Hook Bay, then, escaping along the shore of Sandy Hook, rush into the ship channel, causing a rip and counter drift at the point of the Hook. At this time (9^h) the current of the main ship channel runs east (velocity 1·3 miles per hour), that of the eastern section of the Bay, north, (velocity 0·5), that of the middle east by south, (velocity 0·5), and that of the western, east by south, (velocity 0·2).

The point of greatest curvature, in the sweep of the ebb drift through Sandy Hook Bay, moves continually to the westward, as will be seen by comparison of the conditions at 9^h and 11^h, (see diagrams 4 and 5, sketch 3). This grand movement ultimately creates a counter drift near the point of the Hook, which assumes the form of a whirl as the current of the ship channel slackens. The ebb (northwardly) is the dominant current in the eastern section of Sandy Hook Bay; it commences to prevail three hours before the flood of the ship channel slackens. It is evident that this earlier drift is the lateral draught created by the stream of the ship channel, since as we have previously shown, its domain increases with the velocity of the main stream, and it prevails generally in the eastern section of the Bay, when the main stream has reached its maximum velocity. Moreover, our several stations show that the duration and velocity of this northwardly drift are alike dependent upon the distance from the ship channel.

Lines 1 and 4 of table 6 give the averages of the maximum velocities at several stations as 1 mile of ebb against 0·4 of flood,

and the mean velocities 0·6 of ebb against 0·2 of flood. The mean durations are more than 10 hours of ebb against less than 2 hours of flood.

In the middle of Sandy Hook Bay the ebb current begins nearly two hours before slack water in the main ship channel, its general course is south by east, that of the flood being east by north. The average maximum velocities, given by the 5th line of table 6 are 0·6 of ebb, against 0·4 of flood; the mean rates are above 0·4 of ebb against 0·2 of flood. The durations are about $8\frac{1}{4}$ hours for ebb and $3\frac{1}{2}$ for flood. In the western section of the Bay the ebb commences at nearly the same period as in the main ship channel. The average velocities are nearly equal, and the durations are more nearly so than for the other portions of the Bay. The scouring done by these currents will vary with the product of the duration and the square of the mean velocity, if the material to be acted upon is the same. In the eastern section, therefore, the work done by the ebb is to that done by the flood as 45 to 1. In the middle section the work done by the ebb and flood will be as 9 to 1, while in the western section the feeble labors of ebb and flood are nearly equal, and their directions so nearly opposed that little ultimate scouring is effected. The form of the bottom is in accordance with these results.

Since the tide wave is propagated most rapidly in deep water, it follows that the fall of the tide takes place earlier in the channel than upon the shore; hence the water tends to flow laterally from the shore toward the channel. In this way a convergence of the ebb streams may be expected, especially in shallow bays. With the flood streams the reverse must be true, and the tide wave, rising earlier in the channel, a flow of water takes place toward the shore. In consequence of these distinctive characteristics, the ebb and flood assume an unequal share in the moulding of sandy coasts. The ebb current, with its concentration of forces, is a far more powerful agent than the flood, its scouring capacity along its normal course must be more considerable, and it creates more extensive draught currents. The secondary or draught currents within Sandy Hook, called into activity by the unnaturally constrained flood of the ship channel, cover a district not above one and a half miles in extent, while the draught of the ebb upon the outer shore is sensibly felt twelve miles down the New Jersey coast, it is felt at Long Branch where the primary ebb and flood are almost extinct.

Again, the ebb stream holds its course across the middle of shallow basins, in a narrow stream, while the flood, dispersive in its character, pursues the broadest possible path, and presses along the shores. We are prepared, therefore, even in the absence of draught currents, to find the flood predominating over the ebb

in certain localities near the shore. It is not probable that the axis of the grand ebb current has moved northward to avoid Sandy Hook, but rather that it naturally converges at the mouth of New York Harbor, and that the weaker flood has not been able to destroy the work which the ebb has *directly or indirectly* accomplished. It is true that the flood at the point of the Hook is sweeping the sand inward—that in fine it is giving this spit of land *the hook form*—but the ebb is the primary working agent, and the characteristic features of all channels, and basins, on alluvial tidal coasts, must, as a rule, reflect the efforts of the ebb current. That part of the growth of the Hook which takes place from the inside, and which is not so considerable as that from the outside, is caused by the draught current along the shore, which we have been engaged in studying. The action of the waves undoubtedly contributes by the standing of the materials to this growth. The material on the inside is less favorable to the action of transportation, and the currents are lost at a moderate distance from the extremity of the Hook.

Table No. 1.

Date. 1856.	Station.	Locality.	Luni Current Interval.		Duration of Current.			Interval after tide of S. Ho'k		Velocity of currents in nautical miles per hour.				Direction of Current.			
			Ebb.	Fl'd.	Tot'l	Ebb.	Fl'd.	Ebb aft'r h w.	Fl'd aft'r l. w.	Maxim'm		Mean.		At maximum.		General.	
										Ebb.	Fl'd.	Ebb.	Fl'd	Ebb.	Flood.	Ebb.	Flood
			H.M.	H. M.	H. M.	H.M.	H.M.	H.M.	H.M.	Mn. Dec.	Mn. Dec.	Mn. dec.	Mn. dec.				
Aug. 2	R	W. end of Gedney's Channel.	8 32	14 53		6 21		1 06	2 10	2·14	1·15	1·22	0·47	E. by S.	N.W.	E. by S.	N.W.
"	Q	Betw'n R. & P.	8 42	14 47		6 05		1 15	2 04	2·17	1·15	1·11	0·80	E.	W.N.W.	E.	N.W. by W.
July 13	R_2	E. end of Gedney's Channel.	8 47	14 57	12 30	6 10	6 20	0 55	0 55	1·15	0·74	0·70	0·57				
" 23	H	Junction of Swash and Gedney's Channel.	8 02	14 36	12 31	6 34	5 57	0 30	1 04	1·37	1·42	1·10	0·72	E. by S.	N.W.	S.E.	N.W.
Aug. 1	P	S.E. of Flynn's Knoll.	7 48	14 48		7 00		0 20	1 19	1·90	1·42	1·15		E.N.E.	W.N.W.	E. by N.	N.W. by W.
"	O	Main Ship Channel near Flynn's Knoll.	8 18	14 23		6 05		0 50	1 27	1·02	1·53	0·80	0·86	E.	N.W.	E.	N.W. by W.
July 15	A_1	Main Ship Channel N. of E. beacon.	8 30	15 25	12 00	6 55	5 05	0 16	1 09	1·32	1·90	1·02	1·15	E. by S.	W.	E. S.E.	W.
" 23	I	Near O.	8 12	14 35	12 23	6 23	6 00	0 15	0 37	1·63	1·50	1·39	1·10	E. by S.	W. by N.	E. by S.	W. by N.
" 15	A_2	Middle of Ship Channel.	7 43	14 31		6 48		0 11	0 36		2·07				W. by N.		W. by N.
" "	B_2	S. of S.W. Spit.	7 46	14 16	12 08	7 08	5 00	—10	1 00	1·12	0·43	0·47	0·26	E.	N.W. by W.	round the compass.	
" 16	B	Near B_2.	8 12	15 58													

Table No. 2.

R, Q, R_2, H,	8 31	14 48		6 17		0 56	1 33	1·71	1·11	1·03	0·64		E. by S.	N.W.
P, O, A_1, I, A_2,	8 06	14 44		6 38		0 22	1 04	1·47	1·68	1·09	1·04		E. by S.	W. by N.
B_2, B,	7 59	15 07		7 08		—10	1 00	1·12	0·43	0·47	0·26	round the compass.		

Note.—The minus sign is used to indicate that the slack current precedes the stand of the tide wave.

Table No. 3.

Date. 1856.	Station	Locality.	Lunl current Interval.		Duration of current.			Interval after tide of Sandy Hook.		Velocity of Current.				Direction of current.				
			Ebb.	Fld.	Total.	Ebb.	Fld.	Ebb after h. w.	Flood after l. w.	Maximum.		Mean.		At maximum.		Mean.		
										Ebb.	Fld.	Ebb.	Fld.	Ebb.	Fld.	Ebb	Fld.	
			H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	M. dec.	M. dec.	M. dec.	M. dec.					
July 15	U	S. channel E. of main Lt.	8 34	15 41	13 17	7 07	6 10	20	1 25	1·30	1·00	0·71	0·52					
" 18	C	Middle of False Hook Channel,	8 28	14 09	12 49	5 41	7 08	50	25	0·78	1·62	0·50	1·02	S.E.	N. by W.			
" 21	F	W. side Oil Spot,	8 28	13 48		5 20		1 08	28	0·62	0·95	0·35	0·60	S.S.E.	N.W.	S.E.	N.W.	
" 21	G	E. side Oil Spot,	8 11	14 09		5 58		1 10	55	1·04	1·14	0·73	0·62	S.E. by S.	N. by W.	S.E.	N. by W.	
" 24	9	E. of Stake No. 19,	7 07	10 36		3 29		– 25	–3 05	0·35	1·01	0·20	0·40	S.E.	N.W. by N.	S.E.	N.W.	
" 18	D	E. Main Lt., 500 feet from shore,	8 02	13 29	12 42	5 27	7 15	30	– 20	0·62	1·23	0·15	0·72	S.	N.	S.	N. by W.	Shore currents from N. end of Sandy Hook to Long Branch, N.J. in 12 to 18 feet of water.
" 18	E	Off Ocean House, 500 feet from shore,	7 37	11 46	12 09	4 09	8 00	1 15	–2 30	0·17	0·15	0·12	0·07	S.	N.	S.	N.	
" 21		Long Branch 500 feet off shore,	10 42	11 49	11 07	1 07	10 00	3 28	–1 25	0·10	0·15	0·01	0·03	S.S.W.	N. by E.	E.	N.	
Aug. 4	S	Outside False Hook, N. end,	8 09	13 55		5 46		40	50	1·77	1·64	1·06	1·10	S.E.	N.W. by N.	S.E.	N.W. by N.	
" 4	T	S. E. of station S,	8 22	14 03		5 41		1 00	55	1·44	1·44	0·05	·86	S.E.	N.W.	S.E	N.W. by N.	
July 19	V		8 09	14 31	12 22	6 22	6 00	–0 20	1 00	0·20	0·20	0·10	0·12					

Table No. 4.

	S, T, C, F, G,	8 20	14 01		5 41		0 58	0 43	1·13	1·36	0·72	0·84			S.E.	N.N.W.	
	U, South Channel E. of main Lt.,	8 34	15 41	13 17	7 07	6 10	20	1 25	1·30	1·00	0·71	0·52					
	G, S, T,	8 14	14 02		5 48		0 57	0 53	1·41	1·41	0·91	0·86			S.E.	N.W. by N.	

Note.—The minus sign is used to indicate that the slack current precedes the stand of the tide wave.

TABLE No. 5.—*Velocities corrected for diurnal and half monthly inequalities.*

Date 1856.	Station. No	Locality.	Luni current Interval. Ebb.	Luni current Interval. Fld	Duration of current. Total	Duration of current. Ebb.	Duration of current. Fld.	Interval after tide of Sandy Hook. Ebb after h. w.	Interval after tide of Sandy Hook. Flood after l. w.	Velocity of currents in nautical miles per hour. Maximum. Ebb.	Maximum. Fld.	Mean. Ebb.	Mean. Fld.	Direction of current. At maximum. Ebb.	At maximum. Fld.	General. Ebb.	General. Fld.	Depth in feet.	
			H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	M. dec.	M. dec	M. dec.	M. dec						
	7	Near end of Hook 200 ft. off shore,	3 30	14 51	12 21	11 21	1 0	-4 15	1 15	1·40	0·23	0·58	0·12	N.N.E.	N. by W.	N. by E.	N.W.	28	Shore currents.
	6	500 ft. S. of station 7, 200 feet off shore.	3 18	14 37	12 24	11 19	1 5	-4 20	0 35	1 57	1·02	1·09	0·57	N.E.	S.W.	N.E.	S.W.		
	5	Off W. Beacon, 600 ft. and 400 ft. from shore,	5 07	14 42	13 45	9 35	4 10	- 40	- 30	0·78	0·46	0·46	0·21	N.N.W.	S.	N.N.W.	S.	6	Inside Sandy Hook, N.J.
	4	Off Tide gauge, W. of Lt. House,	4 20	14 59	13 14	10 39	2 35	15	-2 50	0·78	0·15	0·43	0·11	N. by E.	S.E. by S.	N.	S.E.	7	
	K	2200 ft. off shore, S. W. of W. Beacon,	5 23	14 18	12 25	8 55	3 30	- 30	0 20	0·43	0·54	0·30	0·35	N. by E.	S.	N. by E.	S.	12	
	L_1	3600 ft. off shore, W. of Lt. House,	4 32	14 19	12 12	9 47	2 25	-3 08	0 40	0·76	0.21	0·44	0·05	N.N.E.	S. by W.	N.N.E.	S.	24	Eastern portion Sandy Hook Bay.
	L_2	1200 ft. S. W. of L_1,	5 09	14 34	11 36	9 26	2 10	-3 25	0 40	0·61	0·35	0·39	0 16	N. by E.	S. by E.	N.	S. by E.	24	
	M_1	W. of Lt. Ho., middle of S. H. Bay,	5 28	14 27	11 39	8 59	2 40	-2 40	0 40	0·50	0·23	0·32	0·07	N.	S.	N.	S.	25	
	M_2	2000 ft. N. E. of M_1,	6 38	14 29	12 02	7 51	4 11	-1 50	1 45	0·32	0·69	0·43	0·26	N.E.	E.S.E.	N.E.	E.S.E.	25	Middle of S. Hook Bay.
	M_3	2000 ft. N. of M_1,	5 58	14 42	11 24	8 44	2 40	-1 50	1 40	0·80	0·47	0·45	0·15	E. by N.	S.E.	E. by N.	S.E.	27	
	N_1	W. of Lt. Ho., North of Port Monmouth,	6 10	14 29	11 49	8 19	3 30	-1 45	00	0·78	0·16	0·45	0·03	E.S.E.	S.W.	E. S. E.	S.W.	30	
	N_3	Between N_1 and N_2,	8 23	14 43		6 20		-0 35		0·30	0·52			S.E.	W.	E.	W.	18	Western portion Sandy Hook Bay.
	N_2	N. end of Port Monmouth Dock,	7 45	14 29	12 54	6 44	6 10	0 35	- 20	0·36	0·42	0·17	0·21	E. by N.	W. by N.	E.	W.	30	
			7 58	13 52	13 24	5 54	7 30	0 10	-1 35	0·26	0·46	0·17	0·23	N.E.	W.N.W.	N.E.	W.	8	

TABLE No. 6.

Nos.													
7 and 6	3 24	14 44	12 22	11 20	1 02	-4 18	55	1·49	0·63	0·83	0 34	N. by E.	W.	28	N.E. portion S. Hook Bay.
5	4 43	14 50	12 29	10 07	3 22	- 12	1 40	0·78	0 30	0·44	0·16	N. by W.	S. by E.	6	Shore currents Sandy Hook.
4	5 23	14 18	12 25	8 55	3 30	- 30	0 20	0·43	0·54	0·30	0·35	N. by E.	S.	12	
K, L_1, L_2	5 05	14 27	11 47	9 22	2 25	3 04	40	0·62	0·27	0·38	0 09	N.	S.	24	East'n portion of S. H. Bay.
M_1, M_2, M_3	6 16	14 33	11 47	8 17	3 30	-1 47	1 08	0 63	0 44	0·44	0·15	E. by N.	S. by E.	27	Middle portion of S. H. Bay.
N_1, N_2, N_3	8 02	14 22	13 10	6 20	6 50	0 03	0 58	0·30	0·47	0 17	0·22	E. by N.	W.	18	West'n portion of S.H. Bay.

NOTE.—The minus sign is used to indicate that slack current precedes the stand of the tide.

Art. XXXVIII.—*On a Supposed Personal Equation in the Use of the Zenith Telescope for Determining Latitudes by Talcott's Method;* by A. D. Bache, Superintendent U. S. Coast Survey.

(Communicated by authority of the Treasury Department.)

The use of the zenith telescope to determine latitudes for the Coast Survey by Talcott's method has been explained in a paper read before the Association at the Cincinnati meeting in 1851. The difference of zenith distance of two stars passing the meridian nearly at the same time, one north and the other south of the zenith, and at nearly the same distance from the zenith, is measured by a micrometer. The sum of the same distance is given by the star catalogue, whence the zenith distances of each star of the pair becomes known, and from its declination the latitude of the place.

Observations at Mount Sebattis Station in Maine, in 1853, seemed to show that this method was not free from personal equation, either of observer or instrument. The same twenty-three pairs of stars observed with zenith telescopes No. 1 by assistant J. E. Hilgard, and No. 2 by sub-assistant J. G. Ottmanns, gave results differing by $1''{\cdot}12$, the probable accidental error of one value of the difference being $\pm 0''{\cdot}77$, and that of the mean $\pm 0''{\cdot}16$. The probable accidental error of one observation was $\pm 0''{\cdot}81$ with the first, and $\pm 1''{\cdot}14$ with the second observer, hence for the mean of each pair, with an average number of three observations on each, the probable errors would be $\pm 0''{\cdot}48$ and $\pm 0''{\cdot}66$ respectively, and for the difference of two such means $\pm 0''{\cdot}81$, scarcely differing from the value above stated, which is derived from a comparison of the differences among themselves.

The residual difference of $1''{\cdot}12$ appears, therefore, in the light of a constant quantity, and there being thus cause to suspect that identical results might not be obtained by two observers, or by two different instruments, a plan of observation was laid out for settling the question.

At the telegraph station, Columbia, S. C., in 1854, assistants B. A. Gould, Jr., and G. W. Dean, observed with zenith telescopes No. 2 and No. 5. The latitude found by Mr. Dean with both instruments was almost identically the same, being with No. 2 $33°\ 59'\ 58''{\cdot}14$, and with No. 5 $33°\ 59'\ 58''{\cdot}10$, with probable errors from twenty-one pairs of stars, with the two instruments respectively of $\pm 0''{\cdot}14$ and $\pm 0''{\cdot}16$. With the same instruments and from the same stars, Dr. Gould obtained $33°\ 59'\ 58''{\cdot}30 \pm 0''{\cdot}18$, and $58''{\cdot}13 \pm 0''{\cdot}18$. The inquiry was continued at Ragged Mountain station, Maine, in 1854, by assistant G. W. Dean and sub-assistant Stephen Harris, under my direction, using the same instruments and observing the same pairs of stars. The resulting latitude from observations on thirty-two pairs of

stars was absolutely identical, with a probable error of $\pm 0''{\cdot}11$ for the result by either observer. A further trial with zenith telescopes No. 10 and No. 2 at Mount Harris station, Maine, by assistant Dean and sub-assistant Goodfellow, under my direction, in which Mr. Dean used both instruments, and Mr. Goodfellow No. 10, gives latitudes differing very slightly. Mr. Dean obtained using zenith telescope No. 10, 44° 39′ 54″·49, and by No. 2, 54″·76, while Mr. Goodfellow using No. 10 obtained 54″·83. The corresponding probable errors of the mean latitudes from thirty-three pairs of stars were $\pm 0''{\cdot}14$, $0''{\cdot}13$, and $0''{\cdot}13$. Finally, at Mount Desert station, Maine, a comparison was made by sub-assistants Edward Goodfellow and Stephen Harris, using zenith telescope No. 5, and observing the same pairs of stars. The latitudes obtained from observations on thirty pairs of stars differed but two hundredths of a second, with probable errors of $\pm 0''{\cdot}13$ and $\pm 0''{\cdot}14$.

The investigation has thus clearly proved that there is no personal equation of observer or instrument in the use of the zenith telescope by Talcott's method, but that identical results can be obtained by different observers, with the same or different instruments using the same pairs of stars for observing. The accuracy, of the final result, depends therefore, upon the accuracy of the declinations of the pairs of stars, upon the use of the proper number of pairs, and upon the care taken in determining the values of the micrometer and level divisions, and in using the instrument. A probable error in observing of from $\pm 0''{\cdot}25$ to $\pm 0''{\cdot}80$ may be expected for one observation, according to the size and quality of the instrument and the ability of the observer. The probable error of the result by a single pair of stars as depending on the catalogue errors of the stars places, will range from $\pm 0''{\cdot}60$ to $\pm 1''{\cdot}00$, which will give from $\pm 0''{\cdot}11$ to $\pm 0''{\cdot}18$ for the latitude as resulting from thirty pairs. The discrepancy in the results obtained at Sebattis may possibly be owing to the warping of the thin ledge of rock on which the instruments were mounted. The unusually large value of the accidental error of observation seems to indicate some disturbing influence.

The following table contains a recapitulation of these results. The first column gives the name of the station at which the observations were made—the second, the date—the third, the instrument—the fourth, the observers name—the fifth, the number of pairs observed—the sixth, the resulting latitude—the seventh, the probable error of the result—the eighth, the probable error of the result by a single pair of stars, derived from a comparison of the mean latitude with the result by each pair,—and the ninth, the probable accidental error of one observation, derived from a comparison of the individual results for each pair of stars with their respective means:

Table showing Results of Observations for Personal Equation in Determining Latitudes by Talcott's Method.

Station.	Date.	Zenith telescope.	Observers.	No. of pairs of Stars.	Latitude.	Prob. error of resulting Latitude.	Prob. error of result by single pair.	Prob. acci. error of one obser.
						±	±	±
Mt. Sebattis.	June, 1853.	No. 1	J. E. Hilgard.	23	44° 08′ 37″·82	0″·16	0″·90	0″·81
		" 2	J. G. Oltmanns.	23	38″·94	0″·22	1″·08	1″·14
Columbia.	Feb. 1854.	No. 2	G. W. Dean.	21	33° 59′ 58″·14	0″·14	0″·62	0″·36
		" 5	do.	21	58″·10	0″·16	0″·75	0″·25
		" 2	B. A. Gould.	21	58″·30	0″·18	0″·83	0″·
		" 5	do.	21	58″·13	0″·18	0″·83	0″·
Ragged Mt.	Oct. 1854.	No. 5	G. W. Dean.	32	44° 12′ 42″·79	0″·11	0″·62	0″·25
		" 5	S. Harris.	32	42″·79	0″·11	0″·65	0″·47
Mt. Harris.	Aug. 1855.	No. 10	G. W. Dean.	33	44° 39′ 54″·59	0″·14	0″·79	0″·29
		" 2	do.	33	54″·76	0″·13	0″·73	0″·37
		" 10	E. Goodfellow.	33	54″·83	0″·13	0″·74	0″·44
Mt. Desert.	Aug. 1856.	No. 5	E. Goodfellow.	30	44° 21′ 06″·37	0″·13	0″·71	0″·41
		" 5	S. Harris.	30	06″·39	0″·14	0″·76	0″·46

Art. XXXIX.—*Sixth Supplement to Dana's Mineralogy*; by the Author.

List of Works, etc.

R. P. Greg, F.G.S., & W. G. Lettsom: Manual of the Mineralogy of Great Britain and Ireland. 484 pp., 8vo, with numerous wood-cuts. London, 1858.—An important contribution to the science, containing detailed descriptions of species and localities, and new forms of crystals, etc.

James Nicol: Elements of Mineralogy, London, 1858.

A. Wyley: Report upon the Mineral and Geological Structure of South Namaqualand and the adjoining Mineral Districts. London, 1857.

Henry James Brooke: On the Geometrical Isomorphism of Crystals. 42 pp. 4to. From the Transactions of the Roy. Soc. of London, 1857. Mr. Brooke has here treated of the subject discussed in the writer's Mineralogy, i, 191–205, in 1854.

W. H. Miller (Prof. Min. Univ. of Cambridge): On the Anharmonic ratio of Radii normal to four faces of a crystal in one zone, and on the Change of the Axes of a crystal. Also on the Application of Elementary Geometry to Crystallography. —Philosophical Magazine for February and May, 1857.

W. H. Miller: An improved method of finding the position of any face in crystals belonging to the Anorthic system.—Phil. Mag., [4], xv, 512.

A. Damour: Recherches sur les Propriétés hygroscopiques des Minéraux de la Famille des Zéolithes. Annales de Chimie et de Physique, [3], liii, 438, Aug. 1858.

C. Boedeker: Die Zusammensetzung der Naturlichen Silicate: ein Beitrag zur Mineralogie und Chemie. 136 pp., 8vo. Göttingen, 1857.

Prof. Dr. Jos. Grailich: Krystallographisch-optische Untersuchungen. Eine von der Kaiserl. Akad. der Wissenschaften am 30 Mai 1857 *Gekrönte* Preisschrift. 236 pp., 8vo, with numerous wood-cuts. Vienna and Olmutz, 1858.—A work of high merit and value, treating of the optical characters of numerous artificial crystals and native minerals, and the modes of optical investigations.

K. J. KREUTZER: Leichtfassliche Anleitung zum Zeichen der Kristall-Flachen und Netze, und zur Anfertigung der Kristallmodelle aus Pappe. 146 pp. 8vo, with an atlas of 10 plates in 4to. Wien.—A work on the determination of the forms of the faces of simple and complex crystals, and the mode of making crystal models out of paper.

Dr. F. X. M. ZIPPE: Die Charakteristik der naturhistorischen Mineral-System, als Grundlage zur richtigen Bestimmung der Species des Mineralreiches. 250 pp., 8vo. Wien.—This volume contains an exposition of the so-called "natural-history" or Mohsian system of minerals, followed by an arrangement according to it of the species, with brief descriptions.

FRIEDERICH HESSENBERG: Mineralogische Notizen. 32 pp. 4to, with 3 plates of figures of crystals; also Fortsetzung (continuation) of the same, 24 pp. 8vo, with 2 plates.—The figures are excellent, and represent many new forms of crystals.

LIEBENER: Die Mineralien Tyrols. 1857.

C. U. SHEPARD: Report on the Pascoe Gold Mine. 16 pp. 8vo. New Haven.—This mine lies in the auriferous belt which extends for 300 miles southwest (South 40° W.) from Macon Co., North Carolina, through Rabun, Habersham, Lumpkin, Dawson, Forsyth, Cherokee, Cass, Polk, Paulding and Carroll Cos., Georgia, and thence across Cherokee, Kendall and Tallapoosa in Alabama. It is for the most part parallel to the southeastern mountain range of the Blue Ridge. The rocks are hornblendic and mica schist with interlaminated quartz, gneiss and talcose slate; they dip 70° to 80° to the southeast. The gold occurs in the interlaminated quartz, and mostly in pyrites. The pyrites is seldom in distinct crystals, and decomposes rather easily; it sometimes constitutes one-fourth of the vein. The associated minerals are magnetite, hematite, ilmenite, chalcopyrite, argentiferous galena, rutile, tetradymite (rare), magnesian garnet, ores of manganese. Garnet, staurotide, kyanite, occur in the mica schist; spodumene is abundant in granite, and with it occur small crystals which appeared to be tin ore.

C. U. SHEPARD: Report on the New Bangor Slate Quarry in Polk Co., Georgia 12 pp. 8vo.

Descriptions of Species.

ALBITE [p. 240].—The albite crystals from Col du Bonhomme, Mont Blanc, according to Hessenberg (Min. Notizen, p. 8), are compounded parallel to the clinodiagonal section, by both the methods illustrated in figures 415 and 416 in the Mineralogy. There is also composition in other crystals parallel to i-$\bar{\imath}$ or the macrodiagonal section. Hessenberg also mentions the new plane $\frac{3}{2}'$ in the albite crystals of Sterzing.

ALLANITE [p. 208, and I, II, III, IV, V].—Occurs with lanthanite at the Sanford ore bed (of magnetic iron), Moriah, Essex County, New York, chiefly along the plane of junction of the ore with the granite walls. The crystals are of large size, some of them eight or ten inches long, six or eight broad, and one to two thick. Apatite is found at the same place in reddish brown crystals. W. P. Blake in this volume, p. 245.

ALUMIAN, *Breithaupt.*—According to Breithaupt's description, (Berg. u. hütt. Zeit., xvii, 53,) alumian is an anhydrous sulphate of alumina, from mines in the Sierra Almagrera, in Southern Spain. Crystals microscopic and probably rhombohedral; traces of cleavage; H.=2—3; G.=2·702—2·781; lustre of small crystals vitreous, of masses weak; color white; subtranslucent.

By Utendörffer's determinations, it contains 37 or 38 per cent of alumina, along with sulphuric acid. Regarding the whole as $\ddot{S}$, the compound is $\ddot{A}l\ddot{S}^2$=sulphuric acid 60·91, alumina 39·09. BB. unaltered; only hygroscopic water is given off.

ALUNOGEN [p. 381, and III].—Alunogen from Puster valley in the Tyrol, afforded L. Barth (Sitz. Akad. Wien, xxiv, 289):

$\ddot{S}$ 36·0	$\ddot{A}l$ (with traces of iron) 15·8	$\dot{H}$ 48·4

whence the usual formula $\ddot{A}l\ddot{S}^3+18\dot{H}$.

ANALCIME.—See *Leucite.*

ANORTHITE [p. 234, and II].—New figures of anorthite from Vesuvius are given by F. Hessenberg (Min. Notizen, p. 6), in which there are the new planes $-1'$, i-$\breve{i}$, $\frac{1}{3}$-$\breve{i}'$, 6-$\breve{i}$.

An analysis of anorthite from the diorite of the Urals, by R. H. Scott, Esq., is given in the Phil. Mag., [4], xv, 518.

APATITE [p. 396, and I, II, III, IV, V].—Crystals of a blue color, called Lazurapatite, occur with lapis lazuli at Bucharei in Siberia according to N. Nordenskiold (Bull. Nat. Moscow, 1857, 224).

ARÆOXENE [p. 364, and IV under Dechenite].—Analysis by C. Bergemann (Leonh. u. Bronn, 1857, 397) of the **aræoxene from Dahn:**

V̈	Ä̈s	P̈b	Ż̈n	Ä̈l, F̈e	P̈	
16·81	10·52	52·55	18·11	1·34	*trace.* = 99·33.	G.=5·79.

No allusion is made to the identity of aræoxene and dechenite, a fact suggested by Dr. Krantz, and sustained by a qualitative analysis published in Supplement IV.

ASPHALTUM [p. 469].—A large deposit of asphaltum occurs in Tschetschna between Terek and Argun (J. f. pr. Chem., lxxiii, 232).

AUERBACHITE, *Hermann.*—Hermann has described under this name (after Dr. Auerbach) a mineral from Mariupol, near zircon in form and composition (J. f. pr. Chem., lxxiii, 209). It is dimetric, with the angle at the basal edges of the pyramid, 86° 30′ to 87°, and at the pyramidal edges 121°. Color brownish gray; lustre weak, greasy; H.=6·5; G.=4·06. Infusible alone, but fuses with hydrated potash. Composition—

S̈i	Ż̈r	F̈e	
42·91	55·18	0·93	ign. 0·95=100,

giving the oxygen ratio of 1 : 1·5. This different composition, less hardness and specific gravity and greater fusibility with potash, distinguish it from zircon [and suggest that it may be an altered zircon, in which part of the zirconia has been removed.]

BAIKERITE, *Hermann.*—A chocolate-brown mineral wax from the vicinity of Lake Baikal (J. f. pr. Chem. lxxiii, 230), of the hardness of wax, but becoming soft with the warmth of the hand; fuses at 52° C. to an oily liquid, and at a higher temperature distils over, leaving a little of a carbonaceous residue. Dissolves in hot ether, naphtha and turpentine. Attacked by alcohol. In 100 parts there are

Wax-like substance insoluble in alcohol,	7·02
" " soluble "	60·18
Thick fluid resin,	32·41
Earthy impurities,	0·39
	100·00

BARYTES [p. 366, and II, V].—A pseudomorph after calcite of the form R^3 (scalenohedron) has been observed at Przibram (Hessenberg, Min. Not. Forts., 23).

BIEBERITE [p. 385].—Bieberite occurs at Tres Puntos, near Copiapo, Chili (W. J Taylor, this vol., p. 134).

BIOTITE [p. 225, and in Suppl. under Mica]—A black mica from Pfitsch in the Tyrol, having G.=2·94, afforded F. Bukeisen (Sitz. Akad. Wien, xxiv, 285):

S̈i	Ä̈l	Ḟe	Ṁg	K̇	Ḣ	Ċa, Mn, Fl	
38·43	15·71	13·04	17·28	11·42	2·76	*trace* =	98·64

BRAUNITE [p. 117].—An impure braunite from a serpentine rock in Engaddin, having G.=3·5, has been analyzed by Bukeisen (Sitz. Akad. Wien, xxiv, 287).

BROOKITE [p. 123, and II, IV].—Pseudomorphs of brookite after sphene are found, according to A. Müller (Verh. Nat. Ges. Basel, 4th Heft, 1857, p. 573), near Markirch in the Vosges. The crystals are one to three lines long and in thin prisms. They occur in granular limestones along with a bluish green alumina-magnesian silicate which is homogenous and massive in texture, and without cleavage.

CALCITE [p. 435, 503, and I, II, III, IV, V].—The calcite from Sparta, New Jersey, associated with zincite, has been named Spartaite by Breithaupt. By measurement $R : R = 104° 57\frac{1}{2}'$; G.=2·808—2·818. An analysis by Jenzsch is given in Suppl. II.—Breithaupt in Berg. u. Hutt. Zeit. xvii, 53.

CARMINE SPAR [p. 410].—F. Sandberger gives the following analysis (Pogg. ciii, 345) of carmine spar:

Arsenic acid (Ǟs) 49·11 Ḟe 30·29 Ṗb 24·55

whence the formula $\dot{P}b^3\ddot{A}s + 5\dot{F}e\ddot{A}s$=Arsenic acid 48·5, sesquioxyd of iron 28·1, oxyd of lead 23·5. G.=4·105.

CASSITERITE [p. 118, and V].—Tin ore occurs at Xeres in Mexico.—C. Bergemann in N. Jahrb. 1857, p. 395.

CELESTINE [p. 368].—Fine crystals from Pschow in Upper Silesia have been described by Websky in the Zeits. G. Ges. ix, 303. The planes (arranged according to the zones in the direction of the brachydiagonal) are as follows: i-$\breve{i}$; i-2, I, i-$\breve{2}$; 4-$\breve{\frac{8}{3}}$; 2-$\breve{4}$, 2-$\breve{i}$; $\frac{5}{3}$-$\breve{\frac{5}{2}}$; $\frac{3}{2}$-$\breve{3}$; $\frac{4}{3}$-$\breve{4}$; $\frac{8}{7}$-$\breve{8}$; $\frac{2}{2}\frac{4}{3}$-$\breve{24}$, (the five preceding planes forming an oblique zone between I and 1-i); $\frac{6}{5}$-$\breve{\frac{12}{5}}$; 1, 1-$\breve{2}$, 1-$\breve{3}$, 1-$\breve{6}$, 1-$\breve{16}$, 1-$\breve{i}$; $\frac{2}{3}$-$\breve{4}$, $\frac{2}{3}$-$\breve{6}$, $\frac{2}{3}$-$\breve{16}$, $\frac{2}{3}$-$\breve{i}$; $\frac{1}{2}$-$\breve{i}$; $\frac{1}{2}$-$\bar{i}$, $\frac{1}{4}$-$\bar{i}$, O.

Pseudomorphs of amorphous quartz after celestine are described by R. Blum and L. Carius, in Pogg., ciii, 628.

CHALYBITE [p. 444, and III, IV].—An iron and magnesia carbonate affording the ratio 1 : 2 between the $\dot{M}g\ddot{C}$ and $\dot{F}e\ddot{C}$, has been named by Breithaupt (Berg. u. hütt. Zeit. xvii, 54) *Sideroplesite*. He gives $R : R$ =107° 6′; G. =3·616—3·660, Analysis of a specimen from Pöhl (of which G.=3·616) afforded Prof. Fritzsche (mean of two analyses), $\ddot{C}$ 41·93, $\dot{F}e$ 45·06, $\dot{M}g$ 12·16; or

$\dot{M}g\ddot{C}$ 26·58 $\dot{F}e\ddot{C}$ 73·42 = 100 = $\dot{M}g\ddot{C} + 2\dot{F}e\ddot{C}$.

Traversella in Piedmont and Böhmsdorf near Schleiz are mentioned as other localities. [Analyses 9, 10, page 445 of Min. are of the same compound.] Another related compound from Mitterberg in the Tyrol, afforded Dr. Khuen (mean of two analyses), $\ddot{C}$ 39·83, $\dot{F}e$ 51·65, $\dot{M}n$ 0·81, $\dot{M}g$ 7·51; or

$\dot{M}g\ddot{C}$ 15·33 $\dot{F}e\ddot{C}$ 84·67 = $\dot{M}g\ddot{C} + 4\dot{F}e\ddot{C}$.

CHONDRODITE [p. 186, and II].—Hessenberg has some notes on the crystals of humite in his Min. Not., p. 14 of the Fortsetzung. [He has overlooked the view of the crystallization of humite taken in the Mineralogy, p. 186 (and Jour. Sci., [2], xiv, 175)—a view that brings out better the isomorphism with chrysolite, and approximates the types closely to one another.] He mentions some new planes; a brachydome, making about 119° 46′ with the plane O; also the plane 4-$\breve{\frac{3}{2}}$. He also mentions the occurrence of the planes 12-$\breve{\frac{3}{2}}$ and $\frac{12}{5}$-$\breve{\frac{3}{2}}$. Assuming that the crystals are monoclinic, the latter two are +, and the other —.

CHRYSOLITE [p. 184].—A crystal of Forsterite, from Vesuvius, is described and figured by Hessenberg (Min. Not., p. 21). It has the planes O, i-$\breve{i}$, i-$\breve{\frac{3}{2}}$, I, i-$\breve{\frac{2}{5}}$, 1-$\breve{i}$, 1-$\bar{i}$, 1-$\breve{2}$, 1.

CLAUSTHALITE [p. 42].—Clausthalite occurs at the mines of Rio Tinto near Seville, in Spain. *Breithaupt* in Berg. u. hütt. Zeit., xvii, 98.

CLINTONITE [p. 297].—Pseudomorphs of Brandisite after pyroxene (fassaite) have been described by A. Müller (Verh. Nat. Ges. Basel, 4th Heft, 1857, p. 569). They are from Monzoniberg in the Tyrol. Some crystals of the fassaite at that locality are untouched, while others have been more or less perfectly changed.

COAL.—On the assaying of mineral coals by the blowpipe, by E. J. Chapman.—Canadian Journal, Toronto, May, 1858.

COLUMBITE [p. 353, and II, IV, V].—Breithaupt has named (Berg. u. hütt. Zeit. xvii, 61) columbite crystals from the Greenland cryolite vein, *Greenlandite*, finding $I:I=141°\,56'$, 1-$\breve{i}$: i-$\breve{i}$ (over P) $=136°\,34'$, 3-$\breve{i}$: 3-$\breve{i}$ (over P) $=79°\,51'$. G.$=5{\cdot}432$ —$5{\cdot}450$. [Breithaupt has erred in making the brachydiagonal of columbite his vertical axis. By changing the position so as to make it conform to the usual position in columbite, then his brachydiagonal becomes the vertical axis, and his vertical the brachydiagonal, and the angles stand thus:

	Middletown Columbite, D.	Greenland Columbite, Descloizeaux.	Greenlandite Breithaupt.	Breithaupt's lettering.
$I:I$	$=100°\,40'$	100° (from $I:i$-$\bar{i}$)	$100°\ 9' =$	$o:o$ over b
i-$\breve{3}:i$-$\breve{3}$	$=136°\,12'$	137° (from i-$\breve{3}:i$-$\bar{i}$)	$136°\,34' =$	$n:n$ over P
$\frac{1}{3}$-$\bar{i}$: $\frac{1}{3}$-$\bar{i}$	$=141°\ 8'$	141°	$141°\,56' =$	$M:M$

It is unnecessary to go further, as these angles determine the values of all the others. An excellent paper on the Greenland columbite by Descloizeaux is referred to in Suppl. IV.—D.]

Breithaupt remarks in the course of his paper that the Tantalite group has an angle of $121\frac{1}{2}°$ to $123\frac{1}{2}°$ for the fundamental prism and thus differs widely from the Columbite group. [It is shown in the Mineralogy, that the relation between the two is by simple ratios, and that they may be regarded as closely approaching in the angle of the fundamental prism.—D.]

COPPER [p. 115 and IV].—A native copper pseudomorph after aragonite, and probably from Lake Superior, has been described by E. Sochting (Pogg. civ, 332).

COPPER NICKEL [p. 52].—A copper nickel from the Sangerhäuser Revier, afforded Grunow (Zeitsch. D. geol. Ges., ix, 40):

As 54·89 S 1·35 Ni 43·21 Fe 0·54

Another ore afforded, As 48·7, Ni 48·4, S 2·8.

DATHOLITE [p. 334, and I, II, III, IV].—H. Dauber (Pogg. ciii, 116) has made new measurement of the crystals from Andreasberg and Toggiana. The form he has determined to be monoclinic, with the inclination of the vertical axis 90° 8′ 40″. i-$\grave{2}:i$-$\grave{2}=76°\,38'\,33''$ at 15° C., 76° 39′ 50″ at 70° C.; in another trial 76° 40′ 16″ at 18° C., 76° 41′ 47″ at 84° C. $O:2$-$i=147°\,42°\,45'$ at 11° C., 147° 42′ 43″ at 80° C.; in another, 147° 36′ 11″ at 11° C., 147° 36′ 13″ at 71° C. $O:i$-$i=90°\ 9'\,46''$ at 18° C., 90° 8′ 42″ at 80° C.; O on the opposite i-$i=89°$ 53° 55′ at 22° C., 89° 54° 8′ at 52° C. The orthodiagonal was more affected by the heat than the clinodiagonal. The planes observed were the following (arranged in vertical zones) O, $\frac{1}{2}$-i, 2-i, 4-i, i-i, −2-i; −5-$\frac{5}{2}$; i-2, −4-2; i-$\frac{3}{2}$, −3$\frac{3}{2}$; $\frac{1}{8}$, I, −4, −2; $\frac{6}{5}$-$\frac{3}{2}$; 4-$\frac{4}{3}$; 2-$\grave{2}$, 4-$\grave{2}$, i-$\grave{2}$, −3-$\grave{2}$; 2-$\grave{4}$, 4-$\grave{4}$; 2-$\grave{i}$, 3-$\grave{i}$, 4-$\grave{i}$, i-$\grave{i}$ (see Supplement III for tables of comparison.)

ENARGITE [p. 87, 506, and IV].—The occurrence of enargite at the mines of Santa Anna in New Granada has been announced by W. J. Taylor (Proc. Acad. Sci. Philad., 1857, p. 168). It is a brittle metallic mineral occurring in small cavities in quartz. The color and streak are grayish black, and the powder has a metallic lustre. BB. decrepitates; on charcoal, the odor of arsenic and a slight incrustation of antimony. An analysis of ·7082 gram afforded:

S 34·50 As 16·31 Sb 1·29 Cu 46·62 Fe 0·27 = 98·99

There was a slight loss in the arsenic. The atomic proportions are Cu : As + Sb : S $=1{\cdot}47:0{\cdot}23:2{\cdot}16$; whence is deduced the constitution $6CuS, AsS^3$.

EPIDOTE [p. 206, and II, III, IV, V].—Hessenberg has described different crystals of epidote (Min. Notizen, p. 23 and Fortsetzung). In the following descriptions the brackets include planes not before observed.

1. Zermatt, O, i-i, 1-i, −1-i, −2-i, −3-i, i-2, i-$\grave{i}$, i-4, 1, −1, −3-3, [−$\frac{1}{4}$, 5-$\grave{5}$, 2-$\frac{4}{3}$].
2. St. Gothard, O, i-i, −1-i, −3-i, i-2, 1, $\frac{1}{8}$-i, [−7-i, −$\frac{1}{4}$-i, −7-7].
3. Bourg d'Oisans, i-i, 1-i, −1-i, 3-i, i-2, i-$\grave{i}$, $\frac{1}{2}$-i, 1-2.
4. Ala, O, i-i, 1-i, −1-i, −3-i, i-2, i-4, 1, −1, −3-3, [−$\frac{1}{4}$, −5-$\frac{5}{2}$, 2-$\frac{4}{3}$, 3-$\frac{3}{2}$, 2-$\grave{2}$].

[The known planes of Epidote enumerated according to the vertical zones, corresponding with the tables in the Mineralogy, are as follows: O; $\frac{1}{3}$-i, $\frac{1}{2}$-i, 1-i, 2-i, 3-i, i-i, -7-i, -3-i, -2-i, -1-i, $-\frac{1}{4}$-i; 2-$\frac{4}{3}$; 3-$\frac{3}{2}$; 1-2, 2-2, i-2, -1-2; -5-$\frac{5}{3}$; 3-3, -3-3; i-4; -7-7; $\frac{1}{2}$, 1, I, -1, $-\frac{1}{2}$; 1-$\grave{2}$, 2-$\grave{2}$; 5-$\grave{5}$; $\frac{1}{2}$-$\grave{\imath}$, 1-$\grave{\imath}$, i-$\grave{\imath}$. It may be repeated here that in this lettering, i stands for ∞ or infinity, and the ` indicates that the number refers to the clinodiagonal. Otherwise the symbols are those of Naumann, except that the useless P is dropped.—D.]

Epistilbite [p. 330, and IV].—H. How has detected this species in Nova Scotia in trap at Margaretville, seven miles east of Port George (this volume, p. 33). It accompanies fine stilbite, and is in small reddish rhombic crystals nearly or quite opaque, and sometimes the only lining in shallow cavities. Analysis afforded Mr. How:

	$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{C}a$	$\dot{K}$	$\dot{N}a$	$\dot{H}$
1.	58·57	15·34	1·58	7·00	0·99	0·99	15·42 = 99·89
1.	58·35	16·73	——	7·87	——	2·10	14·93 = 100

The second analysis is of a Nova Scotia specimen of uncertain locality. The formula is $(\frac{1}{4}\dot{N}a+\frac{3}{4}\dot{C}a)\,\ddot{S}i+\ddot{A}l\ddot{S}i^{3}+5\dot{H}$.

Erubescite [p. 38, and III].—An argentiferous erubescite from the mine of Ramos in Mexico afforded C. Bergemann (L. and Br. N. Jahrb., 1857, p. 394), Sulphur 23·46, copper 62·17, iron 11·79, silver 2·58. G.=5—5·476.

Euclase [p. 267, and II].—The crystals of euclase from the Urals, announced in Suppl. V, have, according to Kokscharov, the following planes (Pogg., ciii. 348, taking the same planes for the fundamental form as in Schabus's paper, -3-3 in Min.), $\frac{1}{2}$-i; i-9; 1, -1, I; 3-$\grave{\frac{3}{2}}$; 2-$\grave{2}$, i-$\grave{2}$, -2-$\grave{2}$; 3-$\grave{3}$; 4-$\grave{4}$; 1-$\grave{\imath}$, 2-$\grave{\imath}$, 3-$\grave{\imath}$, 4-$\grave{\imath}$, 6-$\grave{\imath}$.

Faroelite [p. 328, and IV, V].—H. How has detected faroelite among the trap minerals of the Bay of Fundy, on the shore of Annapolis county, near a small fishing village called Fort George, a few miles to the west of Blomidon (this volume, p. 31). It has hardness 4·5, and gelatinizes perfectly with muriatic acid before and after ignition. Composition according to Mr. How (mean of three analyses):

$\ddot{S}i$	$\ddot{A}l$	$\dot{C}a$	$\dot{N}a$	$\dot{H}$
41·26	29·60	11·71	5·29	12·73

giving nearly the oxygen ratio for $\dot{R}$, $\ddot{R}$, $\ddot{S}i$, $\dot{H}$, $1:3:5:\frac{8}{3}$, whence Heddle's formula $3(\frac{1}{3}\dot{N}a+\frac{2}{3}\dot{C}a)\,\ddot{S}i+\ddot{A}l^{3}\ddot{S}i^{2}+8\dot{H}$.

Garnet [p. 190, and I, II, III, IV, V].—A crystal from granular limestone at Auerbach is figured by Hessenberg (Min. Not., p. 22), which has the new plane i-$\frac{3}{2}$.

Gieseckite [p. 233, and I].—G. J. Brush has described (this vol., p. 64) fine large hexagonal crystals of what appears to be Gieseckite (pseudomorphous nepheline) from Diana, Lewis Co., N. Y. They occur in granular limestone with pyroxene and magnetic pyrites. Some crystals have very distinct prismatic cleavage; others have none, the texture being waxy. The angles also vary much. These diversities, according to Prof. Brush, show that the crystals are pseudomorphs; and the *form* that they were originally nepheline. The hexagonal prisms have the basal edges replaced by a single plane. O:1 (this plane) 133° to 137°, but mostly between 135° and 136°; in some cases between 131° and 139°, with the crystals slightly oblique. H.=3—3·5. G.=2·736—2·75. Color pea-green to leek-green. Lustre mostly feeble, and often waxy. BB. becomes opaque and fuses to a white enamel. Analyses were made of the cleavable and uncleavable kinds, but no essential difference of composition was found. Mean of three analyses by Prof. Brush:

$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	$\dot{H}$	$\dot{C}a\ddot{C}$
45·67	31·51	0·27	0·77	2·20	3·48	0·88	8·21	6·97	0·32

giving the oxygen ratio for $\dot{R}:\ddot{R}:\ddot{S}i:\dot{H}=1:3{\cdot}70:5{\cdot}97:1{\cdot}55$, or $2:7:12:3$, and the formula $(\frac{2}{9}\dot{R}^{3}+\frac{7}{9}\ddot{R})^{3}\ddot{S}i^{4}+3\dot{H}$, or in a more general form $(\dot{R}^{3},\ddot{R})^{3}\ddot{S}i^{4}+3\dot{H}$; and if the water be basic, it becomes $(\dot{R}^{3},\ddot{R},\dot{H}^{3})\,\ddot{S}i$. This last is probably the correct view of the compound, if it be, as supposed, a result of the alteration and attendant hydration of an anhydrous mineral.

Prof. Brush compares the composition with that of liebenerite and the potash pinites in a table, and suggests that some of the latter may have the same origin. He also points out a close approximation chemically to agalmatolite (in part), dysyntribite and parophite. All are probably results of alteration or metamorphism, but perhaps derived from different original ingredients, just as kaolin may come from different minerals.

GADOLINITE [p. 211, and IV].—According to H. Rose (Pogg., ciii, 314), the specific gravity of gadolinite, after thirty trials, is 4·097 to 4·226, and after heating 4·287 to 4·456; the loss by ignition 0·38 to 0·43 per cent.

GAS.—Gases of Volcanos, Deville, Ann. Ch. Phys., [3], lii, Jan. 1858, p. 5.

GREENLANDITE.—See *Columbite.*

GOLD [p. 7, and I, II, V].—New deposits have been found on Frazer's river, north of Oregon, and others near Pike's Peak on the River Fontaine-qui-bouit, in Western Kansas.

GRAMENITE, *Krantz.*—Gramenite comes, according to C. Bergemann (L. and Bronn's N. Jahrb., 1857, 395), from Menzenberg in the Siebengebirge. It resembles in its fine grass-green color pinguite and nontronite and is essentially a silicate of sesquioxyd of iron. In thin lamellæ aggregated together; H.=1; G.=1·87; lustre greasy, as in pinguite; no alumina smell when moistened. BB. acts like pinguite, and in a tube becomes dull brown, giving off much water; becomes magnetic. Decomposed perfectly in acids, but with difficulty. Composition, according to Bergemann:

$\dot{S}i$	$\dot{F}e$	$\dot{A}l$	$\dot{F}e$	$\dot{M}n$	$\dot{M}g$	$\dot{C}a$	$\dot{K}$	$\dot{H}$
38·39	25·46	6·87	2·80	0·67	0·75	0·56	1·14	23·36=100.

The oxygen of the silica is about twice that of the bases. The mineral has proceeded from the decomposition of some feldspathic rock and by the substitution of sesquioxyd of iron for alumina.

HETEROMORPHITE [p. 76].—Found in cob-web forms at Chonta, Peru. W. J. Taylor, this vol., p. 134.

HORNBLENDE and PYROXENE [p. 170, and I, II, III, IV, V].—The relations of pyroxene and hornblende are reviewed by Rammelsberg in Pogg., ciii, 284. The form and composition of the different varieties of the species are considered by the author and important conclusions deduced.

Wollastonite, *Babingtonite*, and *Rhodonite* (Paisbergite) are shown to be isomorphous with pyroxene. [The particulars are not here cited, as Rammelsberg has followed (although he does not say so) what has already been published by the writer. See for *Wollastonite* the Mineralogy, p. 156, and this Jour. Sci., xv, 449 (1853), and for *Babingtonite* and *Rhodonite*, Supplements II and III. Dauber showed the relation of these two species in angles, but did not recognise their common relations to pyroxene. See also on the relations of spodumene to pyroxene in crystallization, by the writer, in this Jour. Sci., vol. x, p. 120 (1850), where also the relations *in composition* are shown, in the manner now adopted by Rammelsberg; and on the same crystallographic relations by Rammelsberg in 1852, Pogg., lxxxv, 544.

Edenite of Breithaupt is a whitish aluminous hornblende from Edenville, N. Y.; it has $I : I = 124° 22'$; G.=3·059, R. (2·90 Br.)

Ægirine from Brevig is a pyroxene with the angle $I : I = 86° 52'$. The name is also improperly applied to a black hornblende from the same region. *Acmite* is well known to have the form of pyroxene; and *Pyroxene* a simple relation in form to *Hornblende* generally [see Min., p. 166].

He takes up next the relations in composition, dividing the group into 1, silicates of protoxyds; 2, silicates of protoxyds and sesquioxyd of iron; 3, silicates of protoxyds and sesquioxyd of iron with alumina, or aluminous augites and hornblendes; 4, silicates of protoxyds with alumina and no sesquioxyd of iron, as in spodumene. The aluminous species *all contain alkalies.*

I. *Bisilicates of protoxyds.*—The light colored pyroxenes (diopside, malacolite, &c.) have in general the composition $\dot{C}a^3\ddot{S}i^2 + \dot{M}g^3\ddot{S}i^2$. White pyroxene (*malaco-*

lite) from Retzbanya afforded Rammelsberg, $\ddot{S}i$ 56·03, $\dot{C}a$ 25·05, $\dot{M}g$ 17·36, $\dot{F}e$ 1·38 =99·82; giving the oxygen ratio for the bases and silica 14·40 : 29·09=1 : 2·02; and that between the lime and the other bases 7·16 : 7·24.

Tremolite and Actinolite afforded on analysis the following results: 1, colorless from St. Gothard, G.=2·930; 2, yellowish white columnar from Sweden, G.=2·930; 3, white from Gouverneur, N. Y., G.=3·00; 4, greenish white columnar from the Island Maneetsok, Greenland, G.=3·004; 5, green actinolite from Greiner in the Zillerthal, in talc, G.=3·067; 6, grayish green actinolite from Arendal, in large crystals, G.=3·026.

	$\ddot{S}i$	$\dot{C}a$	$\dot{M}g$	$\dot{F}e$	$\ddot{A}l$	ign.
1*a*.	57·72	13·95	27·45	*tr.*	——	0·33= 99·45
1*b*.	58·38	13·86	26·90	*tr.*	——	0·34= 99·48
1*c*.	58·25	14·03	[27·33]	*tr.*	——	0·39=100
2.	58·87	11·00	28·19	*tr.*	1·77	0·18=100·01
3.	57·40	13·89	25·69	1·36	0·38	0·40= 99·12
4.	54·71	15·06	23·92	2·41	——	3·33= 99·43
4. (ign. excl.)	56·60	15·58	24·74	2·48	——	——= 99·40
5.	55·50	13·46	22·56	6·25	——	1·29= 99·06
6.	56·77	13·56	21·48	5·88	0·97	2·20=100·86

The oxygen ratio for the bases and silica in 1, 1 : 2·03—2·09; in 2, 1 : 2·00; in 3, 1 : 2 02; in 4, 1 : 1·97; in 5, 1 : 2·02; in 6, 1 : 2·07. The ratio is *the same therefore, as in diopside*, 1 : 2; and the only difference is that *in the hornblendic mineral the lime is to the other bases as* 1 : 3, *instead of* 1 : 1, or the formula is $\dot{C}a^3\ddot{S}i^2+3\dot{M}g^3\ddot{S}i^2$ in place of $\dot{C}a^3\ddot{S}i^2+\dot{M}g\ddot{S}i^2$.

Anthophyllite is also a similar bisilicate, having the formula $\dot{F}e^3\ddot{S}i^2+3\dot{M}g^3\ddot{S}i^2$.

II. *Bisilicates of protoxyds and sesquioxyd of iron.—Acmite* afforded Rammelsberg on analysis (mean of results):

$\ddot{S}i$ 51·66, $\ddot{T}i$ 1·11, $\ddot{F}e$ 28·28, $\dot{F}e$ 5·23, $\dot{M}n$ 0·69, $\dot{N}a$ 12·46, $\dot{K}$ 0·43, ign. 0·39=100·25. It affords the oxygen ratio, for $\dot{R}$, $\ddot{R}$, $\ddot{S}i$, 1 : 1·85 : 5·86; or for all the bases and silica 2·85 : 5·86=1 : 2·06. Whence the ratio is the pyroxene ratio instead of that of hornblende, and the formula is $(\dot{N}a,\dot{F}e)^3\ddot{S}i^2+2\ddot{F}e\ddot{S}i^2$, in which $\dot{F}e:\dot{N}a=1:3$. G.= 3·530.

Ægirine afforded

$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$
50·25	1·22	22·07	8·80	1·40	5·97	1·28	9·29	0·94=100·72

whence the oxygen ratio for $\dot{R}$, $\ddot{F}e$, $\ddot{S}i$=1·04 : 1 : 4·03, and the formula $\dot{R}^3\ddot{S}i^2+\ddot{F}e\ddot{S}i^2$, in which $\dot{R}$= equal parts of each $\dot{F}e$, $\dot{C}a$ and $\dot{N}a$.

Babingtonite afforded (mean):

$\ddot{S}i$	$\ddot{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a, \dot{K}$	ign.
51·22	11·00	10·26	7·91	19·32	0·77	*trace.*	0·44=100·92

whence the oxygen ratio $\dot{R}:\ddot{R}:\ddot{S}i$=9 89 : 3·30 : 26·59, and the formula $3\dot{R}^3\ddot{S}i^2+\ddot{F}e\ddot{S}i^2$, in which $\dot{F}e:\dot{M}n:\dot{C}a$=4 : 3 : 10.

Arfvedsonite affords the formula $2\dot{R}^3\ddot{S}i^2+3\ddot{F}e\ddot{S}i^2$. Rammelsberg obtained (mean):

$\ddot{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{F}e$	$\dot{M}n$	$\dot{C}a$	$\dot{M}g$	$\dot{N}a$	$\dot{K}$	ign.
51·22	*trace.*	33·75	7·80	1·12	2·08	0·90	10 58	0·68	0·16=98·29

in which the oxygen ratio for the bases and silica is 1 : 1·92; and of $\dot{R}:\ddot{R}$=1 : 1·4. Ægirine, acmite, babingtonite and arfvedsonite consist of $\dot{R}^3\ddot{S}i^2$ and $\ddot{F}e\ddot{S}i^2$, in the different ratios, respectively, 1 : 1, 1 : 2, 3 : 1, 2 : 3.

It follows from these results, that the silicates of protoxyds and silicates of sesquioxyds are isomorphous, [a principle recognized and illustrated throughout the Mineralogy through these and other species.]

III. *Aluminous varieties of pyroxene and hornblende.*

Analyses of aluminous pyroxene by Rammelsberg. 1. Augite from Monte Rossi, Etna; small black crystals; powder gray; G.=3·376. 2–4. Augite from Lake Laach, in crystals; powder gray; G.=3·348.

	Si	Al	Fe	Fe	Mn	Ca	Mg	ign.
1.	47·38	5·52	3·85	7·89	0·10	19·10	15·26	0·43 = 99·53
2.	47·52	8·13	5·83	7·77	0·40	18·25	12·76	—— =100·66
3.	51·12	3·38	0·95	5·45	2·63	23·54	12 82	—— = 99·89
4.	50·03	3·72	2·36	6·65	0·15	22·85	13·48	—— = 99·24

Aluminous hornblendes. Analyses by Rammelsberg (mean of results for each):

1. Pale-colored hornblende from Edenville; G.=3·059.
2. Pargasite from Pargas; G.=3·104.
3. Bluish gray hornblende from Monroe, Orange Co., N. Y.; G.=3·123.
4. Foliated, from Saualpe, Carinthia: G.=3·102; $I:I$=124° 8′—12′.
5. Black, ferruginous, from near Bosgolowsk, Urals; G.=3·214.
6. Ibid., Pargas; G.=3·215.
7. Ibid., Arendal; G.=3·276.
8. Ibid., Philipstadt, Wermland; G.=3·278; $I:I$=124° 30′.
9. Ibid., Brevig; G.=3·428; $I:I$=3·428.
10. Ibid., Fredericksvärn; G.=3·287; $I:I$=124° 7′.
11. Ibid., Vesuvius; G.=3·282.
12. Ibid., Härtlingen; G.=3·270.
13. Ibid., Cernosin, in Bohemia; G.=3·225.
14. Ibid., Honnef, in Siebengebirge; G.=3·277.
15. Ibid., Stenzelberg, ib.; G.=3·266.

	Fl	Si	Al	Fe	Fe	Mn	Ca	Mg	Na	K	ign.
1.	——	51·67	5·75	2 86	——	——	12·42	23·37	0·75	0·84	0·46 = 98·12
2.	2·76	46·12	7·56	——	2·27	*trace.*	13 70	21·22	2·48	1·29	1 10 = 98·50
3.	——	45·93	12·37	——	4·55	0·34	12·22	21·12	2·24	0·98	0 59 =100·34
4.	0·21	49·33	12·72	1·72	4 63	——	9·91	17·44	2·25	0·63	0 29 = 99·13
5.	0·25	44·24	8·85	5·13	11·80	——	10·82	13·46	2·08	0·24	0·39 = 98·27*
6.	1·70	41·26	11·92	4·83	9·92	*tr.*	11·95	13·49	1·44	2·70	0·52 = 99·73†
7.	——	43·18	10·01	6·97	14·48	0 29	11·20	9·48	2·16	1·30	0·37 = 99·44
8.	——	37 84	12·05	4·37	12·38	0 68	14·01	12·16	0·75	2·63	0·80 = 97·67
9.	Ti 1·01	42·27	6·31	6·62	21·72	1·13	9·68	3·62	3·14	2·65	0·48 = 98·63
10*a*.	" 0·80	40·00	8·00	10·10	11·04	1·03	10·26	11·51	2·72	2·53	0 60 = 98·59
10*b*.	" 1·07	40 00	7·37	10·45	13·38	1·85	11·28	7·51	[5·25]		0 54 = 98 70
11.	——	39·92	14·10	6·00	11·03	0·30	12·62	10·72	0·55	3·37	0·37 = 98·78
12.	" 1·01	42 52	11·00	8·30	9·12	——	12·25	13·45	1·71	1·92	——=101 28
13.	" 0·80	40·65	14·31	5·81	7·18	——	12·55	14·06	1·64	1·54	0·26 = 99·10
14.	" 1·53	41·01	13·04	5·38	10·75	——	9·31	13·48	1·26	1·79	0·79 = 98·34
15.	" 0·19	39·62	14·92	10·28	7·67	0·24	12·65	11·32	1·12	2·18	0·48 = 99·67

* Ti 1·01 included.

† Ti *trace.*

Rammelsberg compares the oxygen ratio of the bases, and silica; of the protoxyds, sesquioxyds, and silica; of the protoxyds on the one side with the sesquioxyds and silica on the other; of the protoxyds and sesquioxyd of iron on the one side with the alumina and silica on the other; and concludes that the last (which was first proposed by Bonsdorff) is the right method.

This method, applied to the above analyses of aluminous pyroxene and hornblende, gives for the oxygen of the silica and alumina, that of the other bases being 1, the following numbers: for the *pyroxenes*, 1·78, 2·06, 2·02, 2·06; *hornblende*, 1, 2·09; 2, 2·00; 3, 2·15; 4, 2·62; 5, 2·02; 6, 2·03; 7, 2·06; 8, 1·85; 9, 2·00; 10*a*, 1·70; 10*b*, 1·75; 11, 2·20; 12, 1·93; 13, 2·11; 14, 2·16; 15, 1·99. Hence, *the hornblendes are bisilicates* (or have the ratio 1 : 2) *like all pyroxenes:* and the aluminous species differ in having part of the silica replaced by alumina. In some varieties it is still possible that part of the alumina is basic.

Rammelsberg closes by making some explanations respecting the exceptional cases in the list, and by a recapitulation of his conclusions. The conclusion which is especially new is that the hornblendes have the same oxygen ratio as pyroxene, viz. 1 : 2, between the bases and silica, and hence all are alike *bisilicates.* [The general formula $(\dot{R}^3, \ddot{R})\,\ddot{S}i^2$ includes the whole, as well also as beryl.—D.]

Hureaulite [p. 407].—Crystals of Hureaulite from the quarry of Vilate near Chanteloube. have afforded Descloizeaux the following results (Ann. der Ch. et. de Phys., [3], liii, 293):

Form monoclinic; $I : I = 61°$, $O : I = 90°\ 17'$, $O : ii = C = 90°\ 33'$. Optically biaxial; the two axes very divergent, their plane parallel to the orthodiagonal; the bisectrix positive, and inclined 74° 27′ towards a normal to the base. Color of different varieties, violet, brownish-orange, rose-red; lustre bright; translucent. The crystals approach in habit those of chromate of lead, although quite different in angle. $O : 3\text{-}\breve{i} = 122°\ 53'$ $O : \frac{1}{5}\text{-}\breve{i} = 174°\ 2'$, $O : 1\text{-}\breve{i} = 138°\ 22'$. Various other angles are given in the paper. The violet, yellow and rose varieties differ in their modifications. Composition according to Damour:

	P̈	Ṁn	Ḟe	Ḧ	Mixed sand.
1. Yellow variety,	37·96	41·15	8·10	12·35	0·35 = 99·91
2. " "	38·20	42·04	6·75	12·00	0·50 = 99·49
3. Rose "	37·83	41·80	8·73	11·60	0·30 = 100·26

whence the oxygen ratio for Ḣ, Ṙ, P̈, 1 : 1 : 2, and the formula $(\dot{M}n, \dot{F}e)^5\ddot{P}^2 + 5\dot{H}$.

Ialpaite.—See *Silver-Glance*.

Iron Ores.—The iron ore of the Iron Mountain, Missouri, afforded E. Harrison (Proc. Bost. Soc. Nat. Hist., 1857, p. 295) Iron 68·95, oxygen 27·00, sand, etc., 3·07, manganese trace = 99·02, the composition of hematite, F̈e. An analysis is also given of the ore of Pilot Knob, but the specimen was too impure to afford results of mineralogical interest.

KOKSCHAROVITE, *N. Nordenskiold*.—According to Nordenskiold (Bull. Nat. Moscow, 1857, p. 223), this mineral occurs in crystalline masses, cleavable according to two directions inclined to one another, 124°—124° 5′. H. = 5—5·5; colorless to brown; high lustre, approaching adamantine when colorless. No analysis is given. BB. only a trace of water; fuses easily to a white subtransparent glass; also a clear glass with borax; gives the reaction for silica; a blue color with cobalt-solution. No action with acids. [The angle is that of tremolite or hornblende.]

Lanthanite [p. 436 and I, III, IV].—Lanthanite is found, according to W. P. Blake, (this vol. p. 245) with allanite at the Sanford Iron Ore Bed, Moriah, Essex county, New York. It is in delicate scales or a thin scaly crust in fissures in the ore, and on allanite crystals. The scales or plates have a cleavage, like mica, and some are quite brilliant; lustre pearly; color varying from white to a delicate pink or rose-tint.

Lapis Lazuli [p. 229].—Lapis Lazuli and its associated minerals at Bucharei, Siberia, are described by N. Nordenskiold, in Bull. Soc. Imp. Nat. Moscow, 1857, No. 1, p. 213. It occurs in regular dodecahedrons having also the faces of the cube, H. = 5. Color blue, violet-blue, red, and green. The specimen analyzed by Varrentrapp was probably from Bucharei. The crystals occur in limestone with small crystals of pyrites, apatite, glaucolite and kokscharovite.

Laumontite [p. 307, and IV, V].—According to H. How (this Journal, p. 34) laumontite is abundant at Port George, Nova Scotia; the veins are sometimes three inches thick, and at Margaretville it is colored green by copper.

LECONTITE, *W. J. Taylor*.—The Leconte of Taylor (Proc. Acad. Nat. Sci. Philad., and this vol., p. 273) is a sulphate of ammonia and soda, from a cave (cave of Las Piedras) frequented by bats in the vicinity of Comayagua, Honduras, where it was probably formed from their excrements. Crystallization trimetric; crystals partly narrow prisms an inch long, and partly very short and broad. Faces O, I, $\breve{i}\text{-}\breve{2}$, $\frac{1}{4}\text{-}\bar{\imath}$, $\breve{i}\text{-}\bar{\imath}$. $I : I = 103°\ 12'$; $\breve{i}\text{-}\breve{2} : \breve{i}\text{-}\breve{2} = 115°$, $\frac{1}{4}\text{-}\bar{\imath} : \frac{1}{4}\text{-}\bar{\imath} = 127°\ 30'$ to 128°; 128° gives for $O : 1\text{-}\bar{\imath} = 117°\ 7'$. H. = 2—2·5. Clear and colorless when free from the exterior organic matter; taste saline and rather bitter; permanent in the air. Composition, according to Taylor:

S̈	NH⁴O	Ṅa	K̇	Ḣ	P̈	Org. & Inorg. residue.
44·97	12·94	17·56	2·67	19·45	*trace*	2·41

giving the oxygen ratio for the bases, acid and water, 8·93; 26·94 : 17·28 = 1 : 3 : 2; and the formula $(\dot{N}a, NH^4O)\ \ddot{S} + 2\dot{H}$, in which the ammonia is to the other bases nearly as 4 to 5.

LEUCITE [p. 231, and III, V].—The crystals from Kaiserstuhl, of which an analysis by C. Stamm, is given in Suppl. IV (but incorrectly attributed to Mr. Weltzien) under *Analcime*, are regarded by Rose as altered leucite (Pogg. ciii, 521); and he observes in connection, that an altered seemingly kaolinized leucite from Rocca Monfina analyzed by Rammelsberg (see Suppl. V, under Leucite) is of similar composition. The oxygen ratio for $\dot{R}$, $\ddot{R}$, $\breve{S}i$, $\dot{H}$ in Leucite is 1 : 3 : 8 : 0; in Analcime 1 : 3 : 8 : 2; in the Kaiserstuhl crystals 1·03 : 3 : 7·69 : 2·18; in the Rocca Monfina 0·83 : 3 : 7·10 : 2·11; and another from the same locality 0·68 : 3 : 6·77 : 1·96.

MAGNETITE [p. 105. and II, IV].—Octahedral crystals (having the edges truncated) feebly magnetic and giving a red powder, and consequently possessing the characteristics of hematite, occur, according to E. J. Chapman, (Canadian Journal, No. 16), in a feldspar boulder on Bass Lake, Canada West. Prof. Chapman suggests the question whether the crystals are pseudomorphous after magnetite, or octahedral sesquioxyd of iron, and favors the former conclusion.

MANGANBLENDE [p, 41].—Occurs with tetrahedrite at the mine Preciosa in the district of Puebla in Mexico. C. Bergmann, in L. & Br. Neues Jahrb., 1857, p. 394, where an analysis is given.

MESOLITE [p. 328, and IV].—According to H. How (this vol., p. 32) occurs in Nova Scotia with faroelite (which see), sometimes in large masses; one mass was several inches through, and was said originally to have been as large as a man's head. Also found in the North Mountains of Annapolis. A specimen was impressed with a large crystal of analcime, and had upon it a little stilbite, showing that the analcime was first formed. Structure usually fine fibrous, radiated, and somewhat plumose; sometimes coarser columnar and nearly transparent. Composition, according to H. How:

	$\breve{S}i$	$\ddot{A}l$	$\dot{C}a$	$\dot{N}a$	$\dot{H}$
1. Dried at 212°,	46·84	25·92	9·63	5·21	12·11 = 99·74
2. " "	46·48	27·04	9·63	[4·45]	12·40 = 100.00
3. Dried over HSO_4,	46·71	26·68	9·55	5·68	11·42 = 100·04

whence the formula $3\,(\frac{1}{3}\,\dot{N}a + \frac{2}{3}\,\dot{C}a)\,\breve{S}i + 3\ddot{A}l\,\breve{S}i + 8\dot{H}$.

MIASCITE.—A mineral under this name, supposed to be the miascite in part of Dufrenoy, has been analyzed by A. Gages (Phil. Mag. [4], xv, 180). It is from Miask in Siberia. It consists of fibres mixed with dolomite. The fibres afforded on analysis: Silica 68·181, magnesia 28·909, alumina 2·181, iron *trace* = 99·271. The author supposes that the fibres have been formed from tremolite by alteration, and remarks that the removal of the lime of tremolite leads to the same composition. [There is an approximation in constitution to talc or steatite.—D.].

MICROCLINE [Under Orthoclase, p. 245].—Breithaupt gives the following angles for a green feldspar crystal from Kangerdluarsuk in Greenland, associated with sodalite and Eudialyte, (Berg. u. hütt. Zeit., xvii, 11): $O : i\text{-}\breve{\imath} = 90°\ 22'$ and $89°\ 38'$, and therefore *triclinic*. $O : I' = 113°\ 10'$, $O : I = 112°\ 9'$, $O : 1\text{-}\breve{\imath} = 129°\ 34'$, $i\text{-}\breve{\imath} : I' = 119°\ 13'$, $I : I' = 119°\ 4'$, $I : i\,\breve{\imath} = 121°\ 43'$. The feldspar contains nearly as much soda as potash. Composition according to Mr. Utendörfer (Ibid, p. 12),

$\breve{S}i$	$\ddot{A}l$	$\ddot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{N}a$
66·9	17·8	0·5	0·6	*trace*	8·3	6·5

specific gravity 2·582—2·599. The analyses 15, 16 in Min. p. 244 of green and blue feldspar, by Gmelin, are referred to microcline by Breithaupt. The Norwegian microcline is associated with sodalite and eukolite in zircon-syenite. Utendörfer found it to contain, $\breve{S}i$ 68·16, $\ddot{A}l$ 20·50, $\dot{K}$ 6·62, $\dot{N}a$ 4·72 (Ibid, p. 51).

MOLYBDINE [p. 144].—According to Breithaupt (Berg. u. hütt. Zeit., xvii, 125), molybdine ($\ddot{M}o$) from Altenberg in Saxony crystallizes in trimetric prisms, having $I : I = 136°\ 48'$; and it is therefore isomorphous with valentinite ($\breve{S}b$). Breithaupt also remarks on the approximation in angle between romeine and scheelite, [a point brought out in the Min. i, 197].

MUSCOVITE [p. 221, 508, and under Mica in Suppl.].—The muscovite of Vesuvius is figured by Hessenberg (Min. Notizen, p, 12), presenting the planes O, $\frac{4}{3}$-$\breve{\imath}$, i-$\breve{\imath}$, 4-$\breve{\imath}$, and the hemihedral planes 1, 2, 3-$\breve{3}$, 2-$\breve{\imath}$. $O : 4\text{-}\breve{\imath} = 99° 38'$.

NATROLITE [p. 327].—According to Q. Sella (Nuovo Cimento, vol. vii, number for March, 1858) the Savite has the form and angles of natrolite, and is probably that species. He obtained $I : I = 91°$, $I : \frac{1}{2} = 116° 35'$ (116° 40′ in natrolite) $\frac{1}{2} : \frac{1}{2}$ (mac.) $= 143° 10'$ (143° 20′ in natrolite), $\frac{1}{2} : \frac{1}{2}$ (brach.) $= 142° 38'$ (142° 40′ in natrolite). He remarks that the savite occurred implanted on serpentine, and was not pure from it, and that another analysis would probably show a chemical identity.

OPAL [p. 151, and III, IV].—An artificial hydrophane prepared by Mr. Langlois (Ann. Ch. Phys. [3], lii, 331,) consists of two parts of water and three of silica. It is formed by bringing chlorid of silicium into contact with moist air.

ORTHOCLASE [p. 242, and II, III, V].—Interesting quadruplicate compound crystals of adularia from the Binnen Valley are described by F. Hessenberg in his Min. Notizen, p. 3.

The beautiful white feldspar of the Danburite locality as described by G. J. Brush (this vol., p. 70) is mostly orthoclase, though in part oligoclase. The latter is distinguished by the fine striation of the surface of cleavage.

See also *Microcline*.

OZOCERITE [p. 474, and I, III].—A paper by J. Fritzsche on Ozocerite, and its relations to the Neft-gil of the island Tschelehan in the Caspian Sea, is published in the Bullet. de St. Petersburg, 376–377, and J. f. pr. Chem., lxxiii, 321.

PARALOGITE, *N. Nordenskiold.*—A mineral called Paralogite, from Bucharei, Siberia, occurring in four and eight-sided prisms, afforded Thoreld (Bull. Nat. Moscow, 1857, 221):

$\ddot{S}i$	$\ddot{A}l$	$\dot{C}a$	$\dot{M}g$	$\dot{M}n$	$\dot{N}a$	ign.
44·95	26·89	14·44	1·01	*trace*	10·86	1·85 = 100

Affords the oxygen ratio for $\dot{R}$, $\ddot{R}$, $\ddot{S}i$, 6·96 : 12·56 : 23·35. Crystallization probably trimetric. No cleavage observed. H. = 7·5 ; G. = 2·665 ; color white, blue or reddish-blue; lustre vitreous. BB. fuses easily to a colorless blebby glass. Occurs with lapis lazuli and feldspar. [It appears to be related to scapolite.]

PECTOLITE [p. 305, and II, III].—Greg and Lettsom have published (Man. Min., p. 213) two figures of this species. One of them has a general resemblance to the figure published of wollastonite, [Min., p. 157], as pointed out by these authors, and the same angle nearly between the planes of cleavage [i-i and -1-i], this angle being 95° 25′ in pectolite and 95° 23′ in wollastonite. Also i-i : 5-i in pectolite is given at 159° 30′, which is its value in wollastonite ; i-i : 2 = 132° 54′ in pectolite and 132° 14′ in wollastonite. These coincidences are parallel with others in composition.

PEROFSKITE [p. 345, and II, IV].—Analyses of the perofskite from Schelingen in the Kaiserstuhl, by F. Seneca, (Ann. Ch. Pharm., civ, 371):

$\ddot{T}i$	58.95	$\dot{C}a$ 35·69	$\dot{F}e$ 6·23 = 100·87	G = 4·02
	59·30	35·94	5·99 = 101·23	

Occurs with mica, magnetite, pyrochlore, in small black cubes.

PHENACITE [p. 189, and V].—The optical characters of phenacite have been studied by W. Haidinger (Sitz. Akad. Wien, xxiv, 30). The refraction (which is positive) for the ordinary ray is stated to be (approximately) 1·671 ; for the extraordinary, 1·696.

PHLOGOPITE [p. 224, and I].—According to Websky (Zeits. Geol. Ges. ix, 310) phlogopite in crystals occurs in granular limestone with garnet and idocrase at Alt-Kemnitz, near Hirschberg.

PHOSPHORCHALCITE.—Analyses of the ehlite, a phosphorchalcite, by Nordenskiöld (J. f. pr. Chem. lxxiii, 216),

	Ṗ	Ċu	Ḣ		
1. Ehlite, columnar,	23·03	65·22	7·50=95·75+4·34	malachite,	G.=4·131
2. " massive,	23·15	64·63	6·84=94·62+5·24	"	G.=4 ·07
3. " "	22·72	64·46	6·82=94·00+5·76	"	
4. Phosphorchalcite,	22·39	64·72	6·59=93·70+6·52	"	G.=4 ·24
5. Ehlite, from Ehl,	22·51	66·55	9·03, F̈e 2·11, C̈ *trace*=100		G.=4·198

Nordenskiöld hence concludes that ehlite and phosphorchalcite are identical, and the formula $\dot{C}u^5\ddot{P}+2\dot{H}$.

Hermann objects to the conclusion, and calls the species $\dot{C}u^5\ddot{P}+2\dot{H}$, *Dihydrite;* the species $\dot{C}u^5\ddot{P}+3\dot{H}$, *Ehlite;* and compounds of the two, *Phosphorchalcite* (including all the above analyses). The composition deduced by Kuhn and Rhodius $\dot{C}u^6\ddot{P}+3\dot{H}$ does not appear to exist, and the ehlite of the formula $\dot{C}u^4\ddot{P}+2\dot{H}$ is nothing but libethenite.

Platinum.—On platinum in Borneo, Dr. Bleekerode, in Pogg., ciii, 656.

Plombierite.—See *Zeolite.*

Pyrophyllite [p. 303 and I, V].—A part of the so-called agalmatolite, as shown by Brush (this vol., p. 68) is a *compact* pyrophyllite. He obtained S̈i 65·95, Ä̇l (with some F̈e,) 28·97, Ċa 0·22, K̇, Ṅa 0·25, Ḣ 5·48. Walmstedt, as Prof. Brush observes, found the same composition for some agalmatolite, and suggested the relation to pyrophyllite.

Pyroxene [p. 158, and I, II, V].—Different crystals are figured and described by Hessenberg in his Min. Notizen, p, 18.

A diopside from chlorite schist in the Zillerthal, afford L. Barthe, (Sitz. Akad., Wien, xxiv, 290):

S̈i	Ä̇l	Ċa	Ḟe	Ṁg	ign.	
48·47	8·22	21·96	4·30	15.59	0·73=99·27	G.=3·395

See further under *Hornblende.*

Realgar [p. 31].—A crystal of the realgar of Binnen Valley, Switzerland, has been figured by Hessenberg (Min. Not., p. 14), in which there is the new plane $-2i$, and another from Bereskow with the new planes i-6 and 4-2.

Rœmerite, *Grailich.*—This new mineral described by J. Grailich (Sitz. Akad Wien, 1858, xxviii, 272) comes from the Rammelsberg Mines. It is coarse granular, the grains partly crystalline. Form monoclinic; the crystals simple prisms O, I, i-i. Inclination of the vertical axis ($=O : i$-i)=101° 1′, $O : i$-i=90°, $I : i$-i=129° 18′, $I : I$ (front) 101° 24′, $O : I$=98·30 and 81° 30′. Cleavage clinodiagonal (i-i) perfect. Color rust-brown to yellow; translucent; lustre between greasy and vitreous; H.=2·7; G.=2·174 (mean between 2·15 and 2·18); taste saline, astringent, vitriolic. Composition (mean of two analyses by L. Tschermak):

S̈	F̈e	Ḟe	Żn	Ṁn	Ċa	Ṁg	Ḣ	Gangue	
41·54	20·63	6·26	1·97	*trace*	0·58	*trace*	28·00	0·50	=99·48

whence the formula $\dot{R}\,\ddot{S}+\ddot{F}e\,\ddot{S}^3+12\dot{H}$. BB. the reaction of iron and zinc.

Grailich suggests that coquimbite, according to a specimen in the museum at Vienna, has the optical and other characters of the rœmerite, and the species may turn out identical, although the analyses and crystallographic characters mentioned in the books are different.

Samarskite [p. 355, and II, IV].—Specific gravity, according to H. Rose (Pogg. ciii, 329) of three specimens 5·625, 5·617, 5·6142; another 5·717; according to von Peretz, another 5·68; and according to Chandler, others 5·746, and 5·739. Samarskite gives out a faint light on heating, and diminishes in density, one of 5·601 becoming reduced to a density of 5·485, 5·407, and 5·3736; and another of 5·715 to 5·3735.

Sarcolite [p. 200, and II].—A crystal of sarcolite from Vesuvius is figured by Hessenberg (Min. Not., p. 14), having the planes O, i-i, I, i-2, 1-i, 1, 3, 3-3. $I : 3$=105° or by calculation 104° 52½′.

SAUSSURITE [p. 254, and II, IV].—The saussurite of the euphotides of Mt. Rosa in the Alps, has been examined by T. S. Hunt (this Jour. Sci., xxv, 437), and ascertained to be compact epidote or zoisite (a lime-alumina epidote). H.=7, G.=3·3—3·4. He observes that the analyses of Boulanger of the saussurite of Mt. Genèvre and Orezza made it to be the same. It is related to the massive white garnet of the Green Mts. in Canada, which along with serpentine and hornblende, constitutes a variety of euphotide rocks.

SAVITE.—See *Natrolite.*

SCHRÖTTERITE [p. 337].—J. W. Mallet has described schrötterite from the Falls of Little River, on the Sand Mountain, Cherokee county, Alabama (this vol., p. 79.) It is an incrustation over half an inch thick and partly stalactitic, and when broken resembles gum arabic, being translucent or nearly transparent with a faint brownish tinge. H.=3·5; G.=1·974. Composition (mean of two analyses):

$\ddot{S}i$	$\ddot{A}l$	$\dot{H}$	$\dot{Z}n$	$\dot{F}e$, $\dot{M}g$	$\ddot{S}$
10·53	46·48	41·09	0·77	*trace*	0·80=99·67

affording the formula $\ddot{A}l^4\ddot{S}i+20\dot{H}$.

SELADONITE [p. 116, 511, and I].—A green earth from Kaaden in Bohemia, a product of alteration, afforded v. Hauer (Jahrb. k. k. Geol. Reichs., 1856, 845):

$\ddot{S}i$	$\ddot{A}l$	$\dot{F}e$	$\dot{C}a$	$\dot{M}g$	$\dot{K}$	$\dot{H}$, $\dot{C}$
41·0	3·0	23·4	8·2	2·3	3·0	19·3

The composition is near that of the green earth of Mt. Baldo. It occurs as a plastic mass of a fine green color, connected with basaltic tufa.

SERPENTINE [p. 282, 511, and I, II, III, IV, V].—A slaty serpentine resembling antigorite, from "Windisch Matrei" in the Kalser Valley, Tyrol, H.=3·5, and a fibrous variety, (metaxite), from the same place, H.=2, afforded Dr. H. von Gilm (Sitz. Akad., Wien, xxiv, 287):

	$\ddot{S}i$	$\ddot{A}l$	$\dot{M}g$	$\dot{F}e$	$\dot{H}$	
1. Slaty,	42·42	0·65	38.05	5·71	12·91= 99·74	G=2·593
2. Fibrous,	42·19	0·62	38·71	5·98	12·54=100·04	G=2·564

The composition is that of serpentine.

T. S. Hunt on Ophiolites, this vol., p. 234.

SIDEROPLESITE.—See *Chalybite.*

SILVER GLANCE [p. 37, and I, V,].—Breithaupt has described (Berg. u. hütt. Zeit., xvii, 85) a cupriferous silver glance under the name *Ialpaite* (derived from Jalpa, its Mexican locality). It is blackish lead-gray, and malleable like ordinary silver glance, with monometric cleavage. G.=6 877—6·890. Composition, according to R. Richter:

S 14·36 Ag 71·51 Cu 13·12 Fe 0·79

affording the formula $(\frac{3}{4}\,Ag+\frac{1}{4}Cu)\,S$.

SODALITE [p. 229, and II].—A twin of sodalite is described by Hessenberg (Min. Not., p. 17) in which composition is parallel to a trapezohedral face. The usual mode is parallel to an octahedral face.

SPARTAITE.—See *Calcite.*

STILBITE [p. 332, and III, V].—Stilbite from the Seiser Alpe, having G.=2·0, afforded Bukeisen (Sitz. Akad. Wien, xxiv, 286):

$\ddot{S}i$	$\ddot{A}l$	$\dot{C}a$	$\dot{H}$
52·84	16·30	11·79	17·16=98·09

leading to the usual formula.

[Bukeisen writes the formula $\dot{C}a\,.\,\ddot{A}l+2(\dot{H}_3\,.\,\ddot{S}i_2)$. Stilbite has the oxygen ratio of feldspar 1 : 3 : 12, with the addition of the water; and this relation, (which is part of a general one between the zeolite group and feldspar group,) is wholly disguised by the above arrangement of the constituents. Moreover, in these hydrous silicates, related to the anhydrous, it is altogether probable that part or all of the water is basic instead of acid in its relations, and that the tendency to take up water depends

on the acid requiring a larger supply of base; 1+3 : 12, (=4 : 12,) becomes by the addition of the water 10 : 12; or if two parts only of the water be basic, 6 : 12=1 : 2 with 4Ḣ in excess.—J. D. D.].

TANTALITE [p. 351, and III, IV, V].—Analyses of the Kimito and Tamela tantalite by Weber in H. Rose's laboratory (Pogg. civ, 85):

	Ta	Sn	Fe	Mn	Cu	Ca	
1. Kimito,	75·71	9·67	9·80	4·32	*trace*	——	= 99·50
2. "	76·81	9·14	9·49	4·27	0·07	0·41	=100·19
3. Tamela,	83·90	0·66	13·81	0·74	0·11	——	= 99·22

Sp. gr. of 2, 7·270 in pieces and 7·277 in powder; of 3, 7·383 in pieces, and 7·414 in powder. Rose mentions that the process of analysis followed by Berzelius was not satisfactory. In the same place, Rose cites and reviews other analyses. The tantalite analyzed by Wornum [Min. Anal., 6], was probably from Kimito, where alone the variety containing much tin occurs. The variety with little tin has G.=7·311—7·943, and is found both at Tamela and Kimito; this is the *Tantalite* of Nordenskiöld and the other, the tin and manganese kind, his *Ixiolite* [see Suppl. V]. Oxygen ratio for R̈, S̈n, T̈a, in 1, 3·14 : 2·07 : 14.29; in 2, 3·20 : 1·95 : 14·49; in 3, 3·24 : 0·14 : 15·82. The ratio of oxygen of bases and acids is nearly 1 : 5

But Rose observes that the neutral artificial compounds of tantalic acid which he has formed have the ratio 1 : 4. He says further, that he has obtained compounds with potash and soda in his researches, having the same ratio as above, but the combination was not definite; and also that in the case of the Tamela tantalite, the protoxyd of iron may be extracted by prolonged washing. He hence suggests, that the true ratio for the native tantalites is 1 : 4; and that other ratios are results of alteration leading to an excess of acid.

THERMOPHYLLITE, *Nordenskiöld.*—A mineral from Hopansuo near Pitkaranda in Finland, described by Hermann (J. f. pr. Chem., lxxiii, 213). In crystals and grains in an amorphous steatite-like base, which is probably amorphous thermophyllite. Cleavage perfect; form not distinct; color light-brown to silver-white; lustre pearly; H.=2·5; G.=2·56. BB. exfoliates like pyrophyllite and vermiculite. Resembles chlorite. Composition:

S̈i	Ä̈l	F̈e	Ṁg	N̈a	Ḣ
43·12	4·91	1·99	34·87	1·33	13·14=100

whence the oxygen ratio for Ḣ, R̈, R̈, S̈i, 11·68 : 14·04 : 2·88 : 22·40, and the formula

$(\dot{R}^3, \ddot{R})\ \ddot{S}i\frac{4}{3}+2\dot{H}$.

THORITE.—The annexed observations on orangite are from a letter from E. Zschau to G. J. Brush. The following are the measurements of two crystals of orangite (Thorite). The form is a dimetric prism terminated by a pyramid (planes *I* and 1). The corresponding angles in zircon are added:

	Orangite.	Zircon.
I : 1 = ∞P : P =	132¼°	132° 10′
1 : 1 = P : P =	123¼°	123° 19′
	84¼°	84° 20′

The measurements were made with a common goniometer, and for the present, until other and better crystals are obtained, orangite must be considered as undoubtedly isomorphous with zircon. On the more imperfect of the two crystals, the prismatic face *I* is very large, almost as large as in a long prism of zircon. In the other crystal, these faces are very small, but sufficiently well developed to be easily measured. The crystals appear to have a perfect cleavage, in the direction *I* (∞P), and one less perfect in the direction of the diagonal *i*-*i*. A portion of the best crystal is covered with zircon, and of that variety of form in which the prism is either only slightly or not at all developed. The planes on the zircon appear to be parallel to those of the orangite. Zircon, xenotime, and orangite are, therefore, alike *dimetric*. One specimen of orangite in my possession weighs 2½ ounces, and shows the faces *I* and 1.

TORBANITE, *Greg & Lettsom.*—A coal at Torbane and other places near Bathgate in Linlithgowshire which has been partially changed by heat. It is used for the extraction of lubricating oils. *Greg & Lettsom's* Man. Min., 16.

TRICHALCITE, *Hermann.*—A green arsenate of copper from the Turjinsk Copper Mine, resembling tyrolite, described by Hermann (J. f. pr. Chem., lxxiii, 212). Lustre silky; H.=2·5. BB. decrepitates yields much water and becomes dark-brown; fuses on charcoal in the outer flame to a pearl, and in the inner yields a bead of copper. Composition:

$\ddot{As}$ 38·73	$\ddot{P}$ 0·67	$\dot{Cu}$ 44·19	$\dot{H}$ 16·41=100

whence the oxygen ratio for $\dot{H}$, $\ddot{R}$, $\ddot{As}$, 5·27 : 5 : 3·22. Taking it at 5 : 5 : 3, the formula is $\dot{Cu}^3\ddot{As}+5\dot{H}$.

UNIONITE [p. 239].—The unionite of Silliman has been re-analyzed by G. J. Brush, on a part of the original specimen examined by Silliman, and found to be a white lime-epidote. It contained:

$\ddot{Si}$	$\ddot{Al}$	$\ddot{Fe}$	$\dot{Ca}$	$\dot{Mg}$	ign.
40·61	33·44	0·49	24·13	*trace*	2·22

Specific gravity 3·299. The specimens analyzed by Smith and Brush were received by them from Silliman, jr., but owing to error in the collector who sent them to Silliman, they were not the true unionite. This vol., p. 69.

ZEOLITES.—Mr. Daubrée has given an account (L'Institut, No. 1276, June, 1858) of Zeolites now forming from the thermal waters at Plombières in the remains of an old Roman aqueduct. Among the species, the most common are *chabazite* and *apophyllite*. Both are in fine transparent crystals. The chabazite occurs in the bricks and apophyllite in the lime mortar, which shows that their elements are derived from the material in which they occur. Besides these, the following are also mentioned, though with some doubt, *scolecite*, *harmotome*, *gismondine*, *hydrated carbonate of magnesia*, in pearly plates (the plates rhombic, optically biaxial in a plane normal to that of the laminæ). There are also in the cavities of the masonry *hyalite* and other varieties of opal, and aragonite in acute bipyramidal crystals.

Plombierite.—In cavities exposed to the direct jet of thermal water, a gelatinous substance is precipitated which hardens in the open air, becomes opaque snow-white. It is a hydrated silicate of lime, of the composition $\dot{Ca}^3\ddot{Si}^2+6\dot{H}$. It differs from okenite, and the author proposes for it the name *Plombierite*.

These facts, as Daubrée observes, sustain the conclusion that the zeolites filling cavities in rocks were of aqueous origin and subsequent in formation to the including rock.

Appendix.

FURNACE CRYSTALLIZED PRODUCTS.—At the lead and silver furnace at Ems & Holzappel, hexagonal crystals of a compound of antimony, copper, and nickel, have been observed by F. Sandberger (Pogg. ciii, 526). They consist of Antimony 58·57, copper 32·73, nickel 8·97.

CRYSTAL MODELS.—Models of crystals in wood, well made and convenient for study, may be purchased of A. Krantz, at Bonn, at 16 thalers (or $12.00) for 114 pieces. The same kind of models may be obtained also of H. Dauber, at Gandenheim, in the Duchy of Brunswick, at 11 thalers ($8.25) for 80 pieces, or 8 thalers ($6.00) for 50 pieces: orders are received by the booksellers in Brunswick.

Glass models of great beauty and perfect for class illustration, are sold by F. Thomas, at Siegen, Westphalia. They are made of plate glass; the fundamental forms with their axes within, and the various secondary forms with the fundamental form of each enclosed. The whole collection contains 142 forms; the price varies from 16 silver groschen (40 cents) to 156, according to their complexness; for the whole 142, the price is 215 thalers ($161.30). The catalogue issued by Mr. Thomas announces that the first publication on this kind of model is found in Poggendorff's Annalen, vol. 95, 1855. He should go back of this to the writer's Mineralogy, first edition, 1837. A collection of 50 models, of precisely the same kind, were made by the writer in the year 1836, and each edition of the Mineralogy has contained a paragraph recommending the method (first edition at p. 29, and the last at p. 32). Mr. Thomas's models are made with superior skill, and we commend them strongly to all institutions where the subject of crystallography is taught. The charge for them is reasonable.

Arrangement of the Hydrous Silicates.

As many of the hydrous silicates in the Mineralogy are arranged under the species from which they are supposed to have been derived, and are not included in the section of Hydrous Silicates, the following classified catalogue of the whole is here introduced.

The two divisions adopted in the Mineralogy, (1) the magnesian and iron series with related species, and (2) the alumina series, are retained.

The Talc and Pyrophyllite sections are parallel to one another, one magnesian and the other aluminous; both have species with a soapy feel; pyrophyllite has the same oxygen ratio as talc, and each passes into compact soapy varieties, agalmatolite being in part, as Prof. Brush has shown, a pyrophyllite soapstone.

In the Talc section, the oxygen ratio is augitic or nearly so (1 : 2 or 1 : more than 2); and in the Chlorite section, it is near that of the Mica and Andalusite sections (1 : $1\frac{1}{3}$, to 1 : 1 and 1 : less than 1). The hydrous micaceous species of the Phyllite group is related to the anhydrous micas.

Again, the *Augitine*, *Garnetine* and *Apophyllite* sections are parallel in composition and crystallization with the *Augite*, *Garnet* and *Mica* sections among the anhydrous species; the Zeolite section, as shown in the Mineralogy, is parallel with the Feldspar section, and the Datholite section with the Andalusite section and particularly the Euclase group.

Apophyllite, if the water be considered as basic, has the same oxygen ratio between the bases and silica as muscovite, that is 5 : 6. We do not say that the relation thus indicated is a true one, although adopting it for the present.

Chrysolite and calamine are related in form; if we take $a : b : c$ as the axes of chrysolite, then $a : b : 1\frac{1}{4}c$ will be the axes of calamine. Prehnite also comes near chrysolite, if the dome of most common occurrence, $\frac{3}{2}$-$\bar{i}$, be made the plane I; for in that case, $I : I = 90°\ 15'$, $2\text{-}\bar{i} : 2\text{-}\bar{i} = 80°\ 4'$ and $99°\ 56'$, and $1\text{-}\bar{i} : 1\text{-}\bar{i} = 118°\ 14'$. The cleavage in this case becomes brachydiagonal, as it is in most species with a single perfect cleavage.

It is not possible to make a perfect arrangement of these hydrous species until the chemical relations of the contained water are better understood. The method of classification adopted brings the species together into natural groups, and the arrangement will be found convenient for a cabinet.

DIVISION I.

I. TALC SECTION.

1. Talc Group.

Talc (Rensselaerite), Spadaite,
Meerschaum, Neolite.
Anthosiderite, Chlorophæite, Chlorophanerite, Quincite.

2. Serpentine Group.

Serpentine,
Deweylite (Kerolite and Gymnite),
Hydrophite,
Aphrodite,
Chloropal,
Schiller Spar,
Saponite,
? Boltonite,
? Villarsite.

3. Glauconite Group.

Picrophyll,
Pyrallolite,
Monradite,
Palagonite,
Seladonite,
Crocidolite,
Glauconite,
Strakonitzite.

II. CHLORITE SECTION.

1. Phyllite Group.

Margarodite (Gilbertite, Damourite),
Astrophyllite,
Euphyllite,
Ottrelite (Phyllite),
Stilpnomelane (? Chalcodite),
Eukamptite (Voigtite),
Epichlorite,
Fahlunite (Bonsdorffite, Esmarkite, Chlorophyllite),
Gigantolite (Iberite),
Aspasiolite,
Praseolite,
? Huronite.

2. Chlorite Group.

Hisingerite,
Thuringite,
Pyrosclerite,
Clinochlore (Tabergite), IV.
Chlorite (Pennine, Leuchtenbergite, Pseudophite), VI.
Ripidolite,
Metachlorite,
Delessite,
Aphrosiderite,
Cronstedtite,
Sideroschisolite.

3. Margarite Group.

Margarite, Clintonite, Chloritoid.

DIVISION II.

I. PYROPHYLLITE SECTION.

1. Pyrophyllite Group.

Pyrophyllite, Cimolite.
Doubtful.—Anauxite.

2. Pinite Group.

Pinite, Liebenerite,
Gieseckite,
Pyrargillite, Weissite, Dysyntribite, Parophite.

3. Halloysite Group.

Kaolin, Lenzinite,
Pholerite, Severite,
Halloysite, Volkonskoite.

Bole, Sinopite, Stolpenite, Oropian, Onkosin, Teratolite.—Clays.

4. Allophane Group.

Schrötterite, Allophane, Collyrite.

Appendix.—Scarbroite, Dillnite, Miloschine, Delanovite, Montmorillonite, Smectite, Killinite.

II. AUGITINE SECTION,

(Related to the Augite Section of Anhydrous Silicates.)

1. Pectolite Group. iv.—(Related to the Augite Group.)

Pectolite, Laumontite,
Okenite, Leonhardite.

2. Catapleiite Group. vi.—(Related to the Beryl Group.)

Catapleiite, ? Pyrosmalite.

3. Dioptase Group. vi.

Dioptase,
Chrysocolla, Demidoffite.

III. GARNETINE SECTION.

(Related to the Garnet Section.)

1. Calamine Group. iii.—(Related to the Chrysolite Group.)

Calamine, Prehnite.

2. Cerite Group. vi.—(Related to the Phenacite Group.)

Cerite.

3. Tritomite Group. i.—(Related to the Garnet Group.)

Tritomite.

4. Thorite Group. ii.—(Related to the Scapolite Group. See this Suppl., p. 359.)

Thorite.

5. Carpholite Group.—(Related to the Epidote Group?)

Carpholite.

IV. APOPHYLLITE SECTION.

Apophyllite, Gyrolite.

V. ZEOLITE SECTION.

(Related to the Feldspar Section.)

1. ANALCIME GROUP.—(Related to the Leucite Group.)

Analcime, Glottalite, Ittnerite.

2. CHABAZITE GROUP.—(Related to the Nepheline Group.)

Chabazite, Gmelinite, Levyne.

3. GISMONDINE GROUP.—(Related to the Nepheline Group.)

Gismondine, Edingtonite, Faujasite.

4. NATROLITE GROUP.—(Related to the Feldspar Group.)

Harmotome, Scolecite,
Phillipsite, Faroelite,
Thomsonite, Mesolite.
Natrolite,

5. STILBITE GROUP.—(Related to the Feldspar Group.)

Epistilbite, Brewsterite,
Heulandite, Stilbite.

VI. DATHOLITE SECTION.

(Related to the Andalusite Section, Euclase Group.)

Datholite.

ART. XL.—*A New Mode of Making Commercial Caustic Soda;* by JOHN M. ORDWAY.

IN the manufacture of soda by Le Blanc's process, much trouble is occasioned by the unavoidable presence of unoxydized sulphur compounds in the lixivium of the crude soda or "black balls." In that branch of the business which is most extensively carried on, experience has shown methods by which the difficulty is overcome with tolerable success, and accordingly the manufacturer generally aims to produce a good soda ash as the material from which other desired products are to be made. But many consumers require a caustic alkali, and it is inconvenient and expensive for each one to have special kettles or cisterns to prepare what the soda maker could, with mutual advantage, furnish ready for use. Caustic soda has, therefore, begun to be a regular article of commerce, and the demand would be very great, if the price of a good article bore a juster ratio to that of soda ash. To reduce the cost to a minimum it is evidently necessary that a

caustic soda of fair quality should somehow be obtained directly from the crude soda lye, without the preliminary process of making a clear, desulphurized carbonate. But how this can be done economically, is a problem whose answer has not yet perhaps been reduced to the fewest possible terms. Yet the following process is but one remove from the greatest conceivable simplicity, while it has been found by actual working on the large scale to be sure and effectual, and so easy of execution that any man of good common sense can, by a few trials, acquire all the necessary experience.

The "black balls" made in the usual manner are broken up and fully exhausted by a serial lixiviation, so as to make a solution standing at 15° Baumé. A stronger liquor cannot be made fully caustic. The solution is heated to the boiling point and treated with milk of lime prepared beforehand by slacking lime with about six times its weight of water. Three pounds of lime fully suffice for each cubic foot of the lye.

The resulting carbonate of lime, after thorough draining, may be dried by waste heat and used in making more "black balls."

The clear caustic solution is to be evaporated till it stands at about 45° B.—any salts that may fall being dipped out from time to time. To a quantity of this thick red liquor contained in a cast-iron kettle, so set as to admit of being strongly and uniformly heated, we now add as much fine sesquioxyd of iron as shall somewhat exceed in weight the amount of dry hydrate of soda contained in the liquor. By a little practice one can soon learn to guess quite correctly at the quantity of oxyd required for any particular kettle. There should be so much that when the mixture is dried down with constant stirring it may become a dry substance, and not fuse at a heat just below dull redness. During this drying operation, ammonia is given off in abundance, resulting perhaps from the breaking up of the cyanids commonly present in crude soda. Peculiar, but slight and not unpleasant odors, also arise from the decomposition of the organic impurities of the water used in lixiviation. At last when the water is all driven off, the mixture rapidly absorbs oxygen, and from a black or dark brown becomes rust colored throughout. The fire is now smothered and the roasted product, after standing in the kettle an hour or two with an occasional stirring, is thrown out into a clean iron vessel. As soon as the kettle is cold enough to be in no danger of cracking, it is filled again with a fresh charge, and, excepting these intervals of cooling, the work is continued night and day without intermission.

The rust colored powder, when a sufficient quantity has accumulated, is treated with hot water so as to get a solution standing at about 30° B. This liquor, after standing till it has become perfectly clear, is drawn off and boiled down, by successive gra-

dations, till all the free water is expelled. Soon after the commencement of the evaporation, saline matter begins to fall, consisting of sulphate, sulphite, and carbonate of soda, and this deposit—which should be dipped out as it accumulates at the bottom—continues to form as long as the solution remains at 32° B. Afterwards some chlorid of sodium falls, if there is any present, but when the strength gets beyond 36 B. there is no farther deposition. The first kettle of the set, or the melting kettle, which should be of cast-iron, is kept full till the solution indicates 42° B., and is then finished off without more filling, since the liquor froths a great deal towards the last, and must have plenty of room to spread itself. Finally, the fire is urged till the hydrate of soda is fused, and, if the mass shows any rednes indicative of imperfect roasting, a few handfuls of nitrate of soda are cautiously thrown in to insure complete oxydation. It seldom takes more than one per cent of nitrate to destroy any remaining sulphid. When the melted soda has become quiet and a little of it poured out on a cold iron plate, shows by immediate solidification and its white color that all is right, the whole is laded out into iron molds, from which it is transferred as soon as cold to air-tight casks. When the operations have been conducted with ordinary care, the product is white or a little greyish, and is pure enough for all common uses.

The main feature of this process is an oxydizing operation, in principle not very unlike the roasting of pyritous ores. But the sulphurets of the heavy metals can be roasted, *per se*, while sulphuretted hydrate of soda, it being by itself fusible at the requisite heat, has to be mixed with an inert substance to reduce it to the dry and porous state, and so render its particles entirely and speedily accessible to atmospheric oxygen. And this is why the brown mass must not be allowed to melt. Oxyd of iron seems to be peculiarly suitable for drying up the caustic alkali and separating its particles; and as the same oxyd will serve over and over again indefinitely, we need only enough to last till the first lots used are exhausted of alkali and drained and are ready to be used again. There is no need of drying it. Venetian red is a good form of the oxyd, but I have always used a pure earthy hematite that had first been calcined and ground. It is quite possible that oxyd of manganese, free from silica, would do as well, and probably a mixture of the two oxyds would do better than either by itself.

It may not be amiss to mention that hemispherical cast-iron kettles four feet four inches in diameter and half an inch thick at the sides and three quarters at the bottom, have been found by long trial to be very suitable both for roasting and for melting. In such a kettle 500 pounds of caustic soda may be finished off at once. Larger kettles would be hard to manage and smaller ones would cause a loss of time.

This production of caustic soda may be advantageously carried on in connection with the manufacture of a better quality of soda ash by a method sometimes resorted to. A solution of carbonate of soda cannot be made stronger than 32° B. Accordingly the crude soda lye when evaporated retains in solution all the caustic soda and sulphid of sodium and deposits a very good carbonate which is dipped out, drained, and calcined for soda ash. When the liquor shows by increasing in density beyond 32° B. that the carbonate has all fallen, it can be transferred to other kettles, evaporated till it gets very dense, and then mixed with oxyd of iron and dried down. The roasted product will give a good caustic soda by solution, decantation, evaporation, fusion and deflagration.

ART. XLI.—*On the Preparation of some Pure Sulphates, and particularly of Sulphate of Copper;* by HENRY WURTZ, Prof. Chem. National Med. Coll., Washington.

(Read before the American Association for the Advancement of Science, at Baltimore, April, 1858.)

COMMERCIAL *blue vitriol* always contains sulphate of protoxyd of iron, which cannot be separated by crystallization, owing to the fact, determined by Mitscherlich,* that ferrous sulphate, when crystallizing with sulphate of copper, assumes the pentehydrated composition and triclinic form of the latter, and forms with it homogeneous crystals. It has appeared to me desirable, therefore, that some special method be devised for the separation of the iron, both in order that the chemist may possess a source of pure compounds of copper, and because the presence of iron must be injurious in those processes of dying, calico-printing, etc., in which blue vitriol is used, and in the preparation of the cupriferous pigments, *verdigris*, *Paris green*, etc.

In undertaking this, my aim has been to produce a method by which the iron may be directly separated or abstracted from the solution without the permanent introduction of any foreign substance. My process consists essentially of two steps, the first of which is the conversion of the ferrous into *ferric* sulphate, by boiling with a little *deutoxyd of lead*, and the second is the *complete* precipitation of the ferric sulphate, by boiling with a little *carbonate of baryta*. The hot solution is then filtered and allowed to crystallize, when large crystals of beautiful form and color are obtained, containing no trace of iron.† Deutoxyd of lead is prepared for this purpose by boiling *minium* with dilute nitric or acetic acid in the usual way, but minium itself, if free from

* Gemlin's Handbuch, iii, 461.

† Specimens were exhibited to the Section

soluble impurities, may be used directly in ordinary cases, although a portion of the oxyd of copper also is thereby precipitated. *Deutoxyd of barium* is of course also applicable.

In cases where the presence of a little *lime* in the product is of no moment, as for the use of the calico-printer and manufacturer of pigments, carbonate of lime may be substituted for that of baryta.

In addition it may be remarked that if the blue vitriol contains traces of *manganese*, as is extremely liable to occur, this contamination, as would appear from the observations of Schönbein* and Wolcott Gibbs,† must also be entirely removed.

The same treatment is evidently applicable to some other sulphates, and I therefore present it as a general method for the removal of iron from the sulphates of bases precipitated with difficulty by carbonate of baryta, namely, those of *the alkalies, magnesia, manganese, zinc, cadmium, mercury, nickel, cobalt* and *protoxyd of iron*. Of these the most important one practically is the sulphate of magnesia. The mode of proceeding with this would be precisely similar to that with the copper salt, as it would be also with the sulphates of zinc, cadmium, mercury, nickel, and the alkalies. With regard to the manganous sulphate, it must be remembered that deutoxyd of lead, as observed by Schönbein, wholly precipitates sulphate of manganese from its boiling solution; so that the deutoxyd must be used only in small excess over the necessary quantity. The same precaution applies, in a modified manner, to the treatment of the cobaltous sulphate, because Gibbs states that the salts of this metal are also partially precipitated by long boiling with an excess of the deutoxyd, passing first to a higher state of oxydation.

As to the protosulphate of iron, I have already (New York Jour. Pharmacy, i, 229) recommended the use of carbonate of baryta for the removal from it of sesquioxyd of iron. In the same paper (which has, I believe, entirely escaped notice from other Journals, owing to the irregularity with which the *exchanges* of that publication were effected) I have given, among other observations upon the purification of copperas, another method of obtaining its solution free from ferric sulphate, namely, by acidulation with sulphuric acid and agitation with a little pulverized *protosulphid of iron*, by which the sesquioxyd is immediately reduced to protoxyd.

To return again to the sulphate of magnesia, before leaving the subject, I must add that the treatment with carbonate of baryta, according to a former observation of my own,† must re-

* Pogg. Annalen, lxxviii, 162.

† Contributions to Analytical Chemistry, Am. Jour. Sci. [2], xiv., 204.

† New York Jour. Pharm., i, 161; also Ch. Gaz., 1852, 268; Ph. J. and Trans., xii, 77; Dingl. Pol. J., 125, 275; also quoted in Lieb. & Kopp's Jahresbericht, 1852, p. 360.

move also entirely the *sulphate of lime* which usually contaminates commercial Epsom salt; for, as I have there stated, carbonate of baryta totally precipitates gypsum from its solution, even in the cold; and I have there proposed it as a means of removing the gypsum from spring or sea-water which is to be used in steam boilers, (thus preventing *incrustations*,) as well as from the brine of salt works. I have since found that *carbonate of lead* has the same power of precipitating gypsum, and may possibly be a *cheaper* agent for the purpose than carbonate of baryta, considering the facility with which the lead may be *recovered* from the resulting mixture of sulphate of lead and carbonate of lime, in a metallic form.*

* Although not wholly relevant to the subject of this paper, I may be pardoned a few additional remarks upon this subject of the removal of gypsum from waters. When we call to mind that the *crystallization* of the gypsum from its hot solution is the *principal*, and usually the *only* cause of the formation of the destructive boiler-crusts; and that, leaving out of view the injury sustained by the boiler, the actual *loss of heat* through the non-conducting power of the crust and other causes connected with it, has been shown to amount, in the case of *locomotive boilers* (in France), in many cases to 40 per cent of the fuel consumed, the subject may be considered worthy of further attention; and I shall, therefore, present some brief *calculations* bearing upon it.

In a saturated solution of gypsum then (say, in round nnmbers, 1 part in 400) each 800 lbs. = 800 pints = 100 gallons will contain 2 lbs., and each 1000 gallons 20 lbs. of sulphate of lime; which is equivalent to 24 lbs. of pure carbonate of baryta, or a little over 31 lbs. of pure carbonate of lead. But water used for steam purposes, sea-water for instance, is seldom or never a *saturated* solution of gypsum. Let us take von Bibra's analyses of the waters of the Atlantic Ocean, (Liebig & Kopp's Jahresb. für 1850, 621,) collected at four different times, at as many widely distant places. These give in 100 parts 0·205, 0·156, 0·16, and 0·19 parts of sulphate of lime. For the sake of simplicity, take 0·2: then 1000 gallons = 8000 lbs. contain 16 lbs. of gypsum, The quantity of carbonate of baryta equivalent to this is 19·2 lbs., and of carbonate of lead 25 lbs. Thus one ton (2000 lbs.) of carbonate of baryta, which some years since sold in England (in the form of ground *witherite*) for $20, is theoretically sufficient to separate the gypsum from 160,000 gallons of the water of the Atlantic. On referring now to the evaporative powers of different coals, as determined by Walter R. Johnson, for the United States Navy Department, (Taylor's "Statistics of Coal," introduction, p. lvii; Knapp's Chem. Technology, Am. Ed. i, 45,) we there find that 1 lb., for instance, of Lackawanna anthracite (considered in New York superior for steam purposes) produces 8½ lbs. of steam from cold water; so that to evaporate 100,000 gallons would require $\frac{8\times100.000}{8\frac{1}{2}}$ =94,000 lbs., or 47 tons. 40 per cent of such a quantity is over 18 tons.

I do not, however, by any means recommend the application of this principle to *ocean steamers*, on account of *practical* difficulties, which I see no way to overcome. But *on land* the application is a matter of perfect simplicity. It is only necessary to have the *tanks* from which the boiler is supplied, larger, and to have more of them. While the process of mixture and agitation with the carbonate, and precipitation by standing, is going on in one tank, water may be used from another which has undergone the process. The idea seems to me to be especially applicable to *locomotives*, for which even sea-water may then be used.

Art. XLII.—*Geographical Notices.* No. IV.

The Expedition to verify certain Surveys on the rivers Atrato and Truando, in the Republic of New Granada.—As no complete official report of this survey has yet been published, it is only possible to give at the present time some general information respecting it.

The expedition was organized to verify the survey of the "Atrato inter-oceanic canal route," made by Capt. Wm. Kennish, of New York, and published under the auspices of a company already organized for the prosecution of the enterprise; Lieut. S. A. M. Craven, U.S.N., and Lieut. N. Michler, of the topographical engineers, were selected to conduct the party—the former being intrusted with the care of the hydrography, and the latter of the topography of the route.

They sailed from New York in the U. S. surveying schooner, "Varina" on the 16th of October, 1857, and arrived in the Gulf of Darien off the mouths of the Atrato early in December.

On the 8th of that month they entered the Caño Coquito, one of the mouths of the Atrato, and continued up the main stream for a distance of about ninety miles, as far as the mouths of the rivers Sucio, Salaqui, and Truando.

The Atrato, throughout this entire distance, was found to be a large and beautiful stream, flowing nearly due north, of an average depth of from forty to fifty feet, and a width of from one to two thousand feet, presenting no obstacle to uninterrupted navigation, excepting at its mouths.

In the Caño Coquito, the mouth which has been proposed as the outlet of the canal, the average depth of the water is much less than in the main stream, shallowing to only a few feet on the bar at its entrance. This difficulty is to be obviated by closing some or all of the other mouths, after deepening the Coquito by dredging machines, on the supposition that the force of the current will of itself be nearly if not quite sufficient to keep the channel clear of the soft deposit which now chokes it up. The velocity of the river current is not more than one and a half to two miles per hour, as in the whole distance traversed by the party the rise in elevation is exceedingly gradual, having been estimated at from twenty to thirty feet.

Leaving the Atrato, the party next ascended the Truando as far as the river Nercua, thence following the latter stream, in a northerly direction, for about twelve miles to the river Hingador, at which point the route diverged to the westward, crossing the chain of the Cordilleras. For a few miles above its junction with the Atrato the Truando flows mostly through extensive grassy lagoons, wearing its way in a narrow channel through the soft

clayey deposite, of which the banks are discovered to be composed, when they appear during the drought of the dry season. Thence nearly to the Saltos or falls, its course is "amid a labyrinth of islands," through channels often almost entirely closed by drift timber. It was in this portion of the river, called the "Palisados," that the party experienced the greatest difficulties in forcing their way. Above the Palisados the river was found to widen into a broad and beautiful, though somewhat tortuous stream. Here for the first time, gravel and occasional strata of rocks began to appear in the banks. Throughout the whole course of the Truando above the lagoons, the banks were covered with a heavy growth of timber, which, while it would present an obstacle to the excavation of that portion of the canal, would be easily made to supply the lack of material near the mouth of the Atrato, where it would principally be needed. At the Saltos of Truando, where the river breaks through a narrow spur of the Cordilleras, the channel for several miles was either broken up by shallows and rapids, or confined within walls of rock of exceeding hardness, called, perhaps incorrectly, basaltic in the letter of Lieut. Craven. From the Saltos to the mouth of the Nercua the river was found to reassume its broad and open character, with banks less densely wooded than below. The Nercua is a narrow and crooked stream, flowing mostly in a rocky or pebbly bed. Throughout a great part of the distance passed over on this stream, the party were obliged to wade, owing to the shallowness of the water.

Passing up the river Hingador the party climbed up two magnificent falls, one of an apparent height of at least 150 feet, and afterwards made their way by an Indian trail along and across numerous ridges, running in various directions to the river Potumia, by which they descended to the Pacific. The ridges traversed by the party were only a few hundred feet in height, and exceedingly narrow, and the whole distance from the Nercua to the Pacific does not appear to have been more than twelve or fifteen miles. The depression in the mountains at this point is remarkable, and, when viewed from the Pacific, seems almost as if intended by nature for the facilitation of the great enterprise of inter-oceanic communication. The route of the party terminated, on the Pacific, at what was called by Mr. Kennish Kelley's Inlet, and by the natives Balia Ensenada, or rather on a sandy island exterior to the inlet, and called Isla de la playa del Potumia, located nearly in latitude 7° N.

It seems that a full and complete examination of the region between the river Nercua and the Pacific was prevented by the failure of provisions, and by previous delays caused by the inadequacy of the means of transportation provided for the party. Therefore, after a delay of two days on the Pacific, Lieut. Michler,

with his party, was compelled reluctantly to retrace his steps, and return with all possible speed to the Atrato.

Lieut. Craven made a hasty examination of the Pacific terminus of the route, and a more complete one of the mouths of the Atrato, and the adjacent shores of the Gulf of Darien. His report has already appeared in the public journals, and received the attention and comments of those interested. Lieut. Michler ran a line of levels from the Atrato to the Pacific, and mapped the Atrato to its mouths, and the important data collected by him is yet in course of preparation for the press.

With regard to the climate of the whole region, Lieut. Michler reports a delightful temperature, and cool, refreshing nights. During the whole progress of the party from ocean to ocean, scarcely any rain fell—the season being one of unusual dryness—yet the dewpoint was constantly but very few degrees below the actual temperature. The sky was often obscured by clouds, especially after 10 in the P. M., yet Lieut. Michler had satisfactory opportunities of determining, by astronomical observations, the locations of several of the principal points of the route.

Mr. Schott, the naturalist of the party, furnished himself with numerous notes, which, when published, will be of great interest to the scientific world. His extensive collections were not all received in the best condition, owing partly to the dampness of the country, and partly to accidents resulting from insufficient means of transportation.

As to the practicability of the canal, the determination of which was the main and important object of the expedition, nothing can be definitely known till the publication of the data.

Map of the La Plata Basin.—The United States government have recently published a map of the Basin of the La Plata, based upon the results of the expedition which was commanded by Comm. Thos. J. Page, U. S. N., in the years 1853–4–5–6. The map of the adjacent countries is compiled from the most reliable authorities. The country thus delineated, lies between 54° and 73° W. long. and 12° to 36° South lat. The scale is 1 : 3,000,000. A vertical section of the Rivers Parana and Paraguay, from Curumba to the sea is appended. The whole map has peculiar interest at the present time in view of the departure from this country of a large fleet to sustain the demands of the United States government upon Paraguay.

Hydrography of San Francisco Bay.—Dr. J. G. Kohl, whose investigations for the Coast Survey, in respect to the progress of discovery on the coast of the United States have been previously referred to, has published in the Berlin Zeitschr. für allgem. Erdkunde an elaborate essay on the Hydrography of San Francisco Bay, California, and a History of its discovery and exploration from the time of Cabrillo in 1542 until now.

Gold Medal to Dr. Kane.—The report of a commission of the Imperial Geographical Society of France, awarding to the family of Dr. E. K. Kane, the Gold Medal of the Society for his Arctic discoveries, is published in the May number of their Journal. The course pursued by Dr. Kane is thoroughly reviewed in terms of strong commendation. The discovery of an open sea is accepted as established, though doubts are expressed in respect to its permanency. A postscript to the report refers to an attempt made in London to discredit some of Dr. Kane's discoveries, and then proceeds to confirm the previously expressed opinion of the commission, especially in respect to the Open Polar Sea.

African Explorations.—The news of the safe arrival of Dr. Livingstone in South Africa, has been received with great interest, and there is every reason to believe that with his present attendants and apparatus, his new investigations will surpass the former in importance. A valuable service has been performed by Mr. E. Behm, who publishes in Petermann's Mittheilungen for May last, a methodical sketch of the newly explored regions in South Africa, based chiefly on the observations of Dr. Livingstone, but also derived from the researches and criticisms of Galton, Andersson, Moffat, Ladislaus Magyar, Hahn, Rath, de Costa Leals, Chaillu, Graça, &c. The article, (which extends through fifty quarto pages) discusses, 1, the physical structure and geology, 2, the hydrography, 3, the climatology, 4, the vegetation, 5, the zoology, 6. the ethnography. It is without question the most satisfactory scientific review of what is known in respect to South Africa which has ever appeared. A detailed map of that part of the continent, lying south of 8° S. Lat. is printed with the memoirs, and presents a complete indication of the present state of our knowledge in the lands north of the Orange and Limpopo rivers.

Two new volumes, the fourth and fifth of Dr. Barth's researches in Northern Central Africa have appeared in London, but have not yet been reprinted in this country. They contain an account of the journey from Lake Tsad to Timbuctoo, of his residence during seven months in that hitherto almost unknown city, and of his homeward route.

No intelligence has been received of his intrepid companion Dr. Vogel, but on the contrary, tidings have reached Europe of the death of Baron von Neimans, who had volunteered to go to Dar Fur and Wadai in search of Vogel. Baron von Neimans though only 28 years old, was well known for his observations as a traveller, several valuable articles by him having appeared in Petermann's Journal.

Lieut. Burton, who it will be remembered is penetrating to the Interior of Africa from the Eastern coast, has been heard from as far inland as ten days march from Ugógo in about 6° 30′ S. lat.,

36° 30′ E. long. from Greenwich. This is not the third part of the way from Bagamoyo to the inland sea.

The members of Dr. Baikie's expedition, are still engaged in their explorations upon the Niger. The loss of the "Day Spring," embarrassed their proceedings, and the "Sunbeam," by which its place was supplied, was not able to ascend the Niger till after the rise of its waters in July.

Rev. Samuel Crowther, one of the Missionaries of the Church Missionary Society, who has been in the company of Dr. Baikie, sends home to the Church Missionary Intelligencer, a very full journal of the chief occurrences. Although his observations are not of a scientific character, they present valuable information in respect to the native tribes; and his statements of the spread of the gospel among them, are truly surprising.

We are informed that, at a recent meeting of the "U. S. National Colored Convention," an exploring party was appointed to go to the Niger, and ascertain what inducements exist for colored men from this country to enter into commercial and agricultural pursuits, in the region of that river.

The Desert of Sahara.—The following summary in respect to the Sahara, is translated from Karl Arenz's review of the researches of Barth, Overweg, Richardson, and Vogel.

The Desert of Sahara has been represented as a low, flat plain, scarcely rising above the level of the ocean,—a vast sea of sand, upon which, besides a few craggy lines of rock that project into it here and there, there are no other elevations but those shifting mounds and columns of sand, that, like huge billows, move at the mercy of the wind,—a trackless waste, where the traveller, after many days' journey, may still look in vain for a single trace, either of vegetation or of animal life. Modern researches, however, do not sustain this view. On the contrary, they show beyond a doubt that the Sahara consists mostly of a series of table-lands of a greater or less elevation, jutting up occasionally into mountains, and sometimes divided from each other by valleys, or plains covered with sand, and apparently interminable. Let us take a rapid survey of the principal results bearing upon this point.

On their way from the shore of the Mediterranean to Ghat, Barth's party crossed three high and wide plateaus, parallel with the Mediterranean coast. First, came the Gharian plateau, 2,000 feet high, where first they ascended it, but gradually sloping as they passed on, until it terminated at the moderate height of only 500 feet. Next, the monotonous Hamadah, stretching away at a uniform height of from 1300 to 1600 feet, for 120 miles; and then, after crossing Wadys of 600 to 700 feet elevation, and miniature deserts of 1000 feet, the travellers reached the third, or the Murzuk plateau. This plateau is elevated not far from 1500 feet above

the level of the ocean. Its lowest depression is 900 to 1000 feet high, while other portions attain a height of 1800 to 2200 feet. After leaving the Murzuk plateau, the caravan, as it went toward Ghat, appears to have found a mean altitude of 1250 to 1450 feet; and so likewise for some distance to the southward of Ghat, until it came to the wild mountainous region which lies between Ghat and Air, where it entered a Wady (Adschunscher) lying at a height of 2956 feet, and situated amid mountain peaks that were roughly estimated as about 4000 feet high. From Tin Tellust in Air, the altitude of the region was estimated at 1894 feet, nor can we suppose the southern Hamadah to lie at a much greater depression.

Though the Sahara lies at such an elevation, yet we hear of no very lofty mountains there: in Air, however, we come upon a few single peaks, (the Baghtzen, Dodschen, and others,) but these are only from 3000 to 5000 feet in height. Nor are there any extensive mountain chains, unless we except the line of hills between Air and Ghat, and the Uariat which eastward of the Ghat valley stretches north and south, though even this nowhere rises to any great height. It would appear that the southern part of this quarter of the desert, is even more mountainous in its character than the northern, while this in its turn with its extensive plateaus whose scarped sides give them the appearance of gigantic blocks that have been suddenly pushed up through the ground, possesses a peculiar interest of its own. If we compare these lofty plateaus with similar elevations in Europe, we may conceive of the highest part of the Gharian as being at an equal level with the most remarkable table-lands of Europe, those of Spain and the Morea. The two other plateaus may be compared with the highest of the Swiss and South German table-lands, while the deep lying Wady (500 feet) is about the height of the elevated plains of Bohemia.

This portion of the desert is therefore not low, but lofty, not a monotonous dead-level, but a broken highland; in short, it is a series of table-lands of different elevations. Neither is this portion of the Sahara by any means a sea of sand; in fact, only a comparatively small part of it answers to such a description. But though Sahara, as far as our information extends, proves to be a high land, it does not follow that it is so throughout The probabilities of the case, however, are in favor of this conclusion. The measurements of Vogel, in the year 1853, on his route from Tripoli over Sokna to Murzuk, and thence to Bilma, show that some of the eastern portion of the desert is likewise a highland. It is true that he found the tract between the base of Gharian and Sokna much lower than elsewhere, (Boudschem is only 200 feet above the level of the ocean,) but to the southward of Sokna he ascended a narrow pass of the Black Mountains to

a plateau of 2000 feet in altitude which stretched away in an unbroken surface of from 1360 to 1590 feet, as far as Mursuk, and hence it appeared probable that the Mursuk plateau at its eastern extremity merges into the Hamadah. From Aschenumma, in the neighborhood of Bilma, Vogel writes: "I have ascertained that the Great Desert is one vast plateau formation, of the general height of from 1200 to 1500 feet."

With these data before us, based as they are upon scientific research, we are prepared to give credence to the reports of the natives respecting the mountainous character of many portions of the Sahara. The whole southern region of the Tibbus Desert (Lybian) appears from such reports to be covered with high mountains and mountain ranges; in fact, near its southern border two remarkable mountain clusters have been discovered, the Borghu and the Uadschunga, which are so elevated that the natives dress in furs. But the loftiest mountain in the region of the Tibbus, is Tibesty, to the northeast of Bilma, which, according to our accounts, is visible at the distance of four days' journey; we know, moreover, that the Tibbus, even from the remotest parts of the country, flee for refuge from the attacks of the Tuareg, to its solitary cliffs, which, with their precipitous sides, tower up from the rocky abysses at their base. These rocks are so steep that the Arabs say of them: "Your turban will fall off if you attempt to look up to their summit," and Vogel has aptly compared them to the rock upon which the fortress of Konigstein, in Saxony, is built. In regard to the westernmost and larger portion of the Sahara, we have similar reports from the natives, of mountain chains and lofty highlands; as, for instance, of the Black Mountains, which extend from the coast far to the inland, and of a mountain chain fringed on its eastern border by several oases, that of Tuat, among the rest: but especially renowned is the frowning Haghar group, with its three or four sheer, steep and dizzy walls of rock, each wall 125 miles in length; this is said to be surrounded by an immeasurable sea of sand, and to form the stronghold of the most powerful and the most predatory of all the Tuareg tribes, that of the Haghar Tuareg, who, amid these high mountain fortresses, are compelled to go clad in woolen and furs.

And yet there remains, as well in the northern part of the Sahara as in much of its western portion, room enough for vast patches of sand or salt deserts, among which, according to the accounts of the natives, Tanezruft, lying on the route between Tuat and Timbuctoo, is the most remarkable in extent; and it may be a question whether a scientific exploration will not reveal the existence of the plateau formation at least in some portions also of this desert.

In regard to plants and animals, we find that the necessary

condition of their existence, viz: rain, is by no means so rare a phenomenon as our earlier accounts have led us to conclude. For, though Sahara may perhaps justly continue to be regarded as in the main a rainless belt, yet we find many exceptions in sudden and very copious showers, and it is altogether likely that there are many tracts, like the oasis of Air, which have their regular rainy seasons; for we find even in the northern Hamadah, scattered thickets and a few small birds.

Basle Missionary Society Atlas.—A new atlas, published by the Basle Missionary Society, although especially intended to illustrate the operations of that society, contains much geographical information not accessible in any other work. The maps which it contains are, 1, the World; 2, Africa; 3, Central West Africa; 4, the Southern Wolta District on the African Gold Coast; 5, India; 6, South Mahratta; 7, 8, North and South Kanara; 9, Malabar; 10, China; 11, Sinon District in China. Petermann commends particularly Nos. 4, 6, 7, 8, 9, and 11.

The English and American missionary stations, as well as the German, are distinctly noted. Prefaced to the atlas, is a table showing the present missionary stations of Protestant churches in Africa. It is interesting, not only in a philanthropic, but in a scientific point of view, to trace the distribution of these missions. Twenty-five societies (eight American) maintain stations.

Tobler's Planography of Jerusalem.—The work of Van de Velde on Palestine, is already well known. Its author has now compiled from the English Ordnance Survey and the measurements of Dr. Titus Tobler, a Plan of the Town and Environs of Jerusalem, which the latter illustrates by a special memoir. In this is contained a historical review of the various maps of Jerusalem and the surrounding country, which have been made since the twelfth century, with a critical examination of all that are modern. The plan constructed by Van de Velde, differs in various details from the maps which are commonly received, and bears strong claims to superior confidence. It is distinguished also by its fine execution.

Kotschy's Travels in the Cilician Taurus.—Dr. Theodore Kotschy, one of the keepers of the Imperial Botanical Cabinet in Vienna, has just published an interesting volume which lies before us, containing the results of his researches in the Cilician Taurus. It is introduced to the public by a preface from Dr. Carl Ritter, who speaks in emphatic terms of the valuable aid he has derived from the manuscript communications of Dr. Kotschy, in preparing a new volume of the *Erdkunde* (the second devoted to Asia Minor) which is about to appear from the press.

So little has been known in respect to this most interesting mountain land, and, indeed, in respect to the eastern part of Asia Minor, that the researches of Dr. Kotschy are both new

and important. He paid particular attention to the botany of the region which he visited, and now describes its marked peculiarities. The early part of the volume is an interesting account of his general observations while travelling, including a description of the city of Tarsus. An appendix of one hundred and twenty pages is devoted to scientific details, including papers on the climate, geology, botany and zoology. A long enumeration of the plants which were observed is made, including many which thus far have only been found in that locality. A lithographic sketch and a map are given of the Bulghar Dagh; and a table of the heights in the Cilician Taurus, of which the most elevated is Metdesis, 11,000 feet.

Exploration of Brazil.—The Emperor of Brazil has determined to send out a national scientific expedition for the exploration of the less known provinces of the empire. The party which was to leave Rio Janeiro early in the present year will be divided into five sections, botanical, mineralogical, zoological, ethnological and astronomical and geographical, each under a separate chief. All the members are Brazilians by birth. The head of the party is Francisco Freire Allemao, who is also chief of the Botanical section. The preliminary arrangements of the expedition give promise of important results.

Longitude of Valparaiso.—Recent telegraphic experiments between Santiago and Valparaiso have indicated the difference in time between Valparaiso and Paris to be only $4^h\ 55^m\ 49{\cdot}5^s$, the previously received difference having been $4^h\ 56^m\ 6{\cdot}6^s$. A large part of the coast of South America has accordingly been placed on the maps $17{\cdot}1^s$ in time, or $4'\ 16\frac{1}{2}''$ in arc too far to the west.

Death of Adolphe Schlagintweit.—In India, positive and it is feared authentic information has been received of the death of the explorer and naturalist, Adolphe Schlagintweit, one of the three brothers well known for their scientific researches, pursued under the auspices of the East India Company, in India and among the Himalayas. It appears (says the *Times* correspondent) that a party of Khokandpas, belonging to a tribe in revolt against the Chinese, came into the Yarkand territory in the spring, and drove the few Chinese troops in the villages in the town of Yarkand. In one of the villages near the town the Khokandpas found Schlagintweit residing; and, in the course of conversation, he asked them why they did not attack Yarkand itself, where the Chinese force was so small and they were so numerous. For some unexplained reason they were offended at this question. They retired and held a conversation; the result of which was, that they decided he must be a friend of the Chinese and wished to ensnare them; and in the dead of night, they surrounded his house and killed him, to the great regret of their chief, who has saved some of the unfortunate traveller's instruments.—*Athenæum, Sept.* 18.

D. C. G.

Yale College Library, Oct. 9, 1858.

Art. XLIII.—*On Picric Acids and some of its Salts, with an Advantageous Modification of one of the Processes for obtaining it;* by M. Carey Lea, of Philadelphia.

Picric or properly trinitrophenylic acid may be referred, according to the views of Gerhardt, to the type of water $H_2 O_2$, in which one atom of hydrogen has been replaced by an atom of the hypothetical radical trinitrophenyl $C_{12} H_2 X_3$. Pisani has succeeded in forming the chlorid of this radical and its amid, or ammonia in which one atom of hydrogen has been replaced by it.*

Picric acid, whether crystallized in thin laminæ from water, or in long prisms from alcohol, is, when pure, of a very pale yellow. Its alkaline salts when uncontaminated by foreign matters are of a perfectly pure yellow.

The color of these alkaline picrates varies very much with the specimens of acid with which they are made: the potash salt varies through every shade from yellow to yellowish-brown, or to chestnut with a golden glitter, and so with the ammonia salt. It is a little remarkable that picric acid when first obtained from new sources has been twice described as a new acid, the chrysolepic acid of Schunk and the picranisic of Cahours, in both cases apparently in consequence mainly of the difference in the appearance of the alkaline salts of the new acid from that of those formed with picric acid prepared in the usual way.

The chrysolepic acid of Schunk or picric acid formed by the very prolonged action of nitric acid on aloes, has a greenish shade, and forms a potash salt differing very much in appearance from ordinary picrate of potash. In place of being pure yellow it is chestnut-brown, and the play of colors, which with ordinary picrate of potash is red and green, is with it, purple and yellow. It appears to form larger needles than the ordinary salt, and is a very beautiful substance. A modification of picrate of potash much resembling it may be obtained by crystallizing the ordinary salt with the addition of a very small quantity of picramate of potash, an experiment readily made in the following manner; a small quantity of picric acid is introduced into a test tube, water added and a single drop of solution of protochlorid of tin, the whole is boiled, supersaturated with carbonate of potash, boiled again and filtered hot; picrate of potash will crystallize out, of a shade of red-brown depending in its color upon the amount of picric acid reduced by the protochlorid of tin, which latter must be employed in very small proportion. A similar experiment may be made with the ammonia salt, the pure yellow of which is converted to chestnut-brown by the addition

* Liebig. Ann., xcli, 326.

of a very small quantity of picramate, and to green by a larger one. The resemblance of the salts thus artificially colored to the picrates formed with the acid obtained from aloes is so striking that I was for a long time disposed to believe that the aloes-acid salts derived their color from the presence of picramic acid in extremely small quantity. But as picramic acid is readily oxydized into picric by the action of fuming nitric acid,* the aloes acid ought, by being boiled with fuming nitric acid, to be converted into ordinary picric acid, if the difference between them consisted only in the presence of picramic acid. But this reaction cannot be obtained, whereas the artificially colored salt above mentioned, by being boiled with a large excess of nitric acid and then supersaturated with carbonate of potash, crystallizes in its ordinary place without the slightest admixture of picramic acid. I have not found any process by which picrate of potash prepared from aloes can be brought to the color of the pure salt. By boiling with animal charcoal the red-brown becomes a dirty yellow, which is the nearest approach I have obtained to the normal color.

The picric acid first obtained by Cahours from trinitranisol,† and by him called picranisic acid, has been generally admitted by chemists (with the exception of Gerhardt) to be identical with picric acid, and not merely isomeric with it. It is only difficult to understand how this could ever have been doubted, whether, we look to the source of its formation or to its physical characters. Although the crude acid sometimes gives a dark colored potash salt, it more frequently at once yields a bright yellow one with all the marked characteristics of picrate of potash.

The process for obtaining picric acid from commercial creosote is an advantageous one. The acid obtained is readily purified and gives bright yellow alkaline salts.

A number of experiments were made on the old process of decomposing indigo with nitric acid with very various results, probably depending upon the great difference in the composition of commercial indigo. I have seen the ammonia salt crystallize out clear yellow, and from the mother water by spontaneous evaporation, a green picrate of ammonia deposited which exactly resembled that above described as obtained by the addition of minute quantities of picramite of ammonia. The indigo process is one of the least advantageous.

* Of this fact, though called in question by Gerhardt, [Chimie Organique, iii, 47,] there can, I think, be no doubt.

† In preparing trinitranisol, if the process ordinarily given for obtaining nitranisic acid be followed, a great portion of the product is lost. After acting upon oil of fennel for a sufficient length of time with nitric acid, we are directed to add water to throw down yellowish flocks which are the impure nitranisic acid. I have found that after the complete deposition of the yellow flocks, the mother water still contains the greater part of the nitranisic acid, and by standing for twenty-four hours deposits it.

It has been frequently stated that the picric acid obtained from salacine is so pure as not to require purification. Gerhardt, on the contrary, states that oxalic acid is also produced in the reaction, and I have found it so.

Dr. Stenhouse first pointed out that the yellow Australian gum resin obtained from the Xanthorrhæa hastilis was the most advantageous substance from which to obtain picric acid. This gum, which has not yet reached our markets, is easily procured in London. It varies very much in appearance, some specimens which I have received being very ligneous, others wholly free from woody fibre.

All the processes prescribed for obtaining picric acid from Australian gum, aloes, indigo, &c., (creosote excepted) are similar; they consist in treating the vegetable substance with six or eight times its weight of strong nitric acid in the cold. After the first strong action has ceased, more acid is added, heat is applied and continued for ten or twelve hours, adding acid to supply the place of that driven off. The process is unpleasant on account of the vast volumes of red nitrous fumes thrown off in the earlier stage, and wasteful, inasmuch as more than half the nitric acid used is driven off unaltered. By the following modification of the process, the amount of nitric acid necessary is reduced one-half, and the disengagement of fumes diminished in a still greater proportion. As all the violence of the action is done away with, the fumes may readily be carried off without inconvenience.

Into a flask capable of containing at least two or three quarts, five ounces of Australian gum is introduced in lumps, twelve ounces measure of nitric acid sp. gr. 1·42 or thereabouts, are poured over it, and as soon as the action commences, twenty-five ounces of water (hot is preferable but not essential), *which must be at hand ready measured*, as the action is very sudden, is introduced. A gentle heat is then applied; for about two hours the mass puffs up very much; and if there is danger of running over, cold water may be added, but as little as possible, and the necessity for using any should be avoided by a due regulation of the heat. By degrees the mass subsides, when the heat may be increased, and continued till the bulk of the mixture is reduced to one-half, or even less. Five more fluid ounces of the same acid are then to be added, and the heat continued till the fluid is reduced to where it was before the last addition, and even carried a little further. From four to seven more fluid ounces of nitric acid will be required to complete the operation. After this last addition, the heat is to be continued until the mixture is reduced to the bulk of four or five fluid ounces. After cooling this will be found to have become a cake of picric acid more or less solid in proportion to the point to which the final evaporation has been carried.

The whole of this operation may be carried on in the laboratory without a perceptible escape of acid vapor. A cork in the neck of the wide-mouthed flask with a long-necked funnel, and a bent glass tube sufficiently long to reach within a few inches of the bars of a grate or the air-draft of a stove, will effect this object. By inclining the tube and placing a vessel under its end, a large quantity of nitric acid may be collected, which may be cohobated, and serve to reduce the quantity of fresh acid employed, remembering, however, that it is very weak, having a specific gravity varying from 1·1 to 1·2.

This process might doubtless be extended to other materials, such as aloes, indigo, the refuse of gum bezoin after sublimation of benzoic acid, &c. It does not require more time than the ordinary process.

The purification of the crude picric acid is best effected as follows: The crude acid is well stirred up with a small quantity of water, which after rest, is decanted and the operation repeated. The acid thus washed is dissolved in boiling water, sulphuric acid added in the proportion of eight or ten drops to each pint of solution, which is boiled for a few minutes, and rapidly filtered through a heated filter. It is convenient to filter into a porcelain dish over a lamp. The picric acid is then neutralized with carbonate of potash, or preferably with solution of crystallized bicarbonate, as a troublesome second filtration is thus saved. When the potash salt crystallizes out it is to be thoroughly freed from the mother water and recrystallized. If desired to have a very pure product, it may be boiled with animal charcoal and recrystallized several times. The potash salt is decomposed in a boiling solution with chlorhydric acid, and the picric acid, when thoroughly freed from adhering chlorid of potassium, is pure.

In addition to the reducing agents already known to be capable of converting picric acid to picramic, the same effect may be produced by cyanid of potassium which in the presence of an alkali instantly decomposes picric acid, producing a solution intensely colored by picramic acid. Manganid-cyanid of potassium gives the same result with the aid of heat. By boiling the solution with the addition of fuming nitric acid, it is decolorized to pale yellow, the picramic acid having exchanged an atom of NH_2 for one of NO_4. This reaction affords an extremely delicate test for the presence of a cyanid.

Picrate of Baryta.—By slow evaporation yields prismatic crystals, which are dichromatic. In the evaporating basin they present the appearance of yellow prisms with red summits.

Picrate of Glucina.—Carbonate of glucina dissolves readily in a hot aqueous solution of picric acid, and by evaporation yields golden-yellow crystalline crusts. By heating on platinum foil it

becomes orange-red, boils up and burns with a feeble deflagration, leaving a sooty mark and a loose white ash.

Picrate of Alumina.—Hot solutions of chlorid of aluminum and picrate of ammonia, placed in a beaker glass and left for several days, give beautiful stellar aggregations of crystals which are permanent in the air, and by heating become slightly brown and then detonate. By recrystallization only crystalline crusts are obtained, which no longer detonate by heating, but only deflagrate with a smoky flame.

Picrate of Protoxyd of Manganese.—This beautiful salt, the most interesting of all the picrates, is easily formed by dissolving the protocarbonate of manganese in hot aqueous picric acid. By spontaneous evaporation large prisms belonging to the rhombic system are readily obtained. These prisms exhibits the faces $\infty \breve{P}\infty$, $\infty \bar{P}\infty$, with an intermediate prism face, and the terminal planes 0P. The face $\infty \bar{P}\infty$ is sometimes wanting, and no pyramidal faces were found in any of the very numerous specimens examined.

These crystals are distinctly dichromatic; examined by light transmitted through the prism parallel to its axis, they are of a clear pale yellow color; in any other position they are of a reddish-salmon, varying with the light. If a crystal be held with its prismatic axis vertical, and be viewed horizontally through a Nicols' prism, so placed that the principal section passing through the obtuse trihedral angles of the prism shall be in the same plane as the axis of the crystal, the image is of a fine salmon-red, varying with different specimens. If the same principal axis of the Nicols' prism be turned till it is at right angles to the axis of the crystal, the image becomes clear light amber-yellow.

The picrate of manganese does not appear to be capable of forming double salts with soda or ammonia. A crystal heated on platinum foil becomes deep red and then instantly deflagrates, so suddenly as to project portions which do not take fire.

Picrate of Protoxyd of Iron.—Isomorphous with the manganous and cadmic salts, crystallizing in large greenish-yellow prisms belonging to the rhombic system, and exhibiting the same faces as the manganous salt, viz.: $\infty \bar{P}\infty$, $\infty \breve{P}\infty$ with an intermediate prism face, and the terminal planes 0P. The face $\infty \bar{P}\infty$ is also in this, and the isomorphous cadmium salt, often wanting. It does not, however, appear to possess the dichromatic properties of the picrates of manganese and cadmium, and unless thoroughly protected from the air, peroxydizes gradually on the surface. Even in solution, however, it is sufficiently permanent to be crystallized by spontaneous evaporation in an open evaporating dish; the surface of the solution becomes indeed covered with a film of decomposed salt, but good crystals may be picked out from underneath.

Picrate of Peroxyd of Iron.—Picric acid in solution boiled with freshly precipitated and still moist peroxyd of iron takes up so little of the metal as to give but slight indications with sulphocyanid of potassium. By accurately precipitating picrate of baryta with persulphate of iron and leaving to crystallize by spontaneous evaporation, the perpicrate of iron is obtained in small yellowish red prisms and yellow needles, which, particularly when examined with a lens, exhibit a beautiful amethyst reflexion. Heated on platinum foil, it fuses to a red liquid which grows deeper and deeper in color until it takes fire and burns with a hissing noise.

Picrate of Cobalt.—The neutral salt is readily obtained by adding a somewhat concentrated solution of chlorid of cobalt to a similar one of picrate of soda. If the solutions be hot the salt crystallizes out by cooling. In this way beautiful amber-brown crystals may be obtained which often extend entirely across the evaporating dish, and which must be freed from adhering chlorid of sodium by recrystallization from a small quantity of hot water. This process is more easy and less wasteful than that recommended in the text-books, of digesting picric acid with carbonate of cobalt and separating the neutral from the basic salt by absolute alcohol. Heated on platinum foil, the picrate of cobalt melts, becoming reddish-black and deflagrates with a white light.

Picrate of Nickel.—Hydrated oxyd of nickel readily dissolves in hot aqueous picric acid, giving a yellow solution which yields green crystals by evaporation. By spontaneous evaporation beautiful prisms are obtained, sometimes an inch and a half or more in length. By heat it becomes first yellow, then brown, and finally deflagrates with a brilliant white light.

Ammonia Picrate of Nickel.—This beautiful but very unstable salt is formed whenever an ammoniacal solution of chlorid of nickel is mixed with a soluble picrate. I have generally used picrate of baryta for this purpose. An abundant and highly crystalline bright yellow precipitate takes place, which under the compound microscope is found to consist of bundles of transparent acicular crystals. Even cold water in sufficient quantity decomposes this salt. Placed on a filter and washed the water runs through bright yellow, and after a sufficient time the filter is found to contain nothing but hydrated oxyd of nickel, free from any trace of picric acid, converted partly into basic carbonate by exposure to the atmosphere. The wash water by evaporation yields, as might be expected, crystals of picrate of ammonia. It is, therefore, evident that the salt when precipitated must be washed with the smallest possible quantity of water. Nearly the whole of the picrate of ammonia may be washed out without changing the color of the precipitate, which becomes a bright yellow meal of hydrated oxyd of nickel colored by a trace of picrate, having

undergone no visible change except the loss of its crystalline structure. Heated on platinum foil, the ammonia picrate of nickel turns brown and deflagrates with a brilliant white light.

Picrate of Protoxyd of Chromium.—Chromous acetate dissolved in aqueous picric acid yields a brown solution which by spontaneous evaporation dries up to a crust which shows no trace of crystallization.

Picrate of Sesquioxyd of Chromium.—Basic carbonate of chromic oxyd boiled with aqueous picric acid gives a greenish solution which by spontaneous evaporation affords greenish crusts with no trace of crystallization. But by accurately precipitating the violet modification of sulphate of sesquioxyd of chromium with picrate of baryta, and leaving the filtrate to evaporate spontaneously, minute greenish needles are obtained.

Picrate of Zinc.—Carbonate of zinc readily dissolves in hot aqueous picric acid, and the salt crystallizes out in small prisms which effloresce even in well closed vessels.

Picrate of Cadmium.—Carbonate of cadmium dissolves readily in hot aqueous picric acid, and gives by spontaneous evaporation very beautiful crystals belonging to the rhombic system, and isomorphous with the manganese and iron salts, which it very closely resembles; it is, however, somewhat lighter in color than the manganese salt, and possesses its dichromatic properties in a much inferior degree. It is extremely soluble in water, and the crystals gradually effloresce even in well closed vessels. By continued boiling its aqueous solution deposits a brown powder, probably a basic salt.

Ammonia Picrate of Copper.—This salt bears great resemblance to the corresponding nickel salt. It is readily obtained by mixing a solution of sulphate of copper in ammonia with an alkaline picrate; an abundant precipitate falls, so bulky that if the solutions are somewhat concentrated the mixture becomes pasty. Like the nickel salt, it scarcely bears washing. Boiled with water, a solution of picrate of ammonia is obtained, and brown flakes of oxyd of copper deposited. A portion of the salt covered with a large quantity of water and occasionally stirred for a day or two is entirely decomposed, with deposition of blue flakes of hydrated oxyd of copper. The freshly precipitated salt examined under a good microscope appears highly crystalline. Its color is greenish-yellow with a faint reddish shade, and it has much the lustre and general appearance of the dust upon the wings of butterflies. Heated upon platinum foil, it deflagrates powerfully with a brilliant white light.

Picrate of Peroxyd of Mercury.—Carbonate of peroxyd of mercury dissolves by digestion in aqueous picric acid, and gives by evaporation brilliant orange-colored needles, easily soluble in water, and by exposure to air efflorescing to yellow. Heated it

reddens, melts, takes fire and burns with vivid combustion. The picrate of protoxyd of mercury is a greenish-yellow, very insoluble precipitate.

Picrate of Silver is but slightly soluble. Nitrate of silver poured into a solution of a soluble picrate, as picrate of magnesia causes at first no precipitate, but after a few minutes beautiful radiating clusters of needles form in all directions through the liquid.

Picrate of Urea.—This very beautiful combination is easily obtained by dissolving urea in solution of picric acid. It crystallizes in large fan-shaped aggregations of bright yellow needles, permanent in the air.

Picrate of Quinia.—Alkaline picrates added to solution of sulphate of quinia throw down a bright yellow powder, insoluble in water, but very soluble in alcohol. By spontaneous evaporation of the alcoholic solution in a beaker glass covered with filtering paper, small tufts of yellow needles are obtained. The statement of L. L. Bonaparte quoted in Gerhardt (Chemie Organique, iv, 123) I have not found confirmed. Heated on platinum foil, it burns quietly with a yellow flame.

Art. XLIV.—*On Deep Sea Explorations;* by Prof. W. P. Trowbridge.

Our present knowledge of the depth of the sea, in all quarters of the globe, may be compared to the ideas which existed in the minds of men, with regard to the form of the continent of America, after the first voyages of the old Spanish and English navigators. Previous to the discovery of Columbus, the most exaggerated notions were entertained of the boundless extent, the unfathomable depths, and the dark wastes of that great chaos of waters which no man had yet dared to explore.

The discovery of the great navigator, was quickly followed by the explorations of Ponce de Leon, Cabot, and others, who touched upon various points of the unknown land, and bore back to the old world trophies from the new. Many of the charts made by these bold mariners are still preserved as memorials of their achievements; but what a contrast do they present to the maps of the present day; in most of them, scarcely a resemblance can be traced to the form of the continent which we now inhabit. The world does not cease to honor these adventurous pilots, because their first efforts were not entirely successful: subsequent researches, with the help of continued improvements in the art of navigation, and in astronomical science, corrected their errors without detracting from their merits. But while these vague notions with regard to the superficial extent

of the sea have been removed, and its surface measured with all desirable accuracy, the veil of mystery still obscures its depths. The bottom has been reached at various points, and the world has just witnessed the wonderful stride in human progress, to which the first movements in this new field of scientific investigation have led. It is therefore legitimate, now, to review what has been done; not with a view of criticising the works of those who have been foremost in these discoveries, but with the better motive of seeking for truth and stimulating to renewed efforts those who have already done so much, by suggesting probable causes of error in the results which have been obtained; so that new methods may be devised, if necessary, for establishing with the certainty which science and the popular mind now require the true form of that portion of the solid crust of the earth, which lies concealed beneath the waters of the ocean.

The question of the character of the thin covering of the bottom, has undoubtedly been settled by the examination of specimens brought to the surface. And here we must digress somewhat to refer to the labors of those who were first instrumental in inaugurating deep sea explorations.

In the year 1845, Lieutenant (now Commander) Charles H. Davis, U.S.N., while running a line of deep-sea soundings across the Gulf Stream, under the direction of the Superintendent of the Coast Survey, obtained one cast of 1350 fathoms, and brought up a specimen of the bottom with the "specimen cup" of Lieut. H. S. Stellwagen, U. S. Navy. With regard to this sounding, Lieut. Davis remarked as follows: "U. S. Brig Washington, Oct. 29th, 1845. Sounded with 1300 fathoms line, ($1\frac{3}{4}$ miles,) and found bottom at that depth." "After the lead was felt to strike the bottom, the line became slack, so that the quartermaster could haul it in hand over hand." "It appeared to fall off again from the side of the bank, and took the remainder of the line, amounting to 1350 fathoms" (in all). "*The cup came up filled with a greenish mud, which is preserved.*" "At 3 P. M., sounded again with 715 fathoms line, and found the same bottom as before." The cup referred to, was the Stellwagen cup, which is used by some at the present day. In the explorations of Lieut. Davis, 95 specimens of the bottom, and 25 specimens of water at various depths, were brought up and preserved.* In the suc-

* See Reports of Superintendent of Coast Survey, for 1845, 1846, 1847, 1848.
The following interesting observations are cited from the Report for 1847, p. 25:
"Collections of specimens of the bottom from soundings in this section, were first commenced by the late Lieutenant Commanding George M. Bache, United States Navy, and have been added to every year since 1844, placed in small bottles for easy inspection, and duly labelled. It was the intention of that lamented officer to have classified them during the past winter, and to have placed characteristic specimens upon an off-shore chart on a suitable scale, thus enabling the eye to generslize the results so as to reproduce them methodically arranged, as upon a geological map. In addition to this, the microscopic examination of these specimens could hardly fail

ceeding year, in the same explorations, soundings were made to the depth of 1500 and 2160 fathoms, without finding bottom; but in the latter case the temperature of the water was recorded at the depth named. In 1848, in the explorations off Cape Hatteras, the officer engaged in the explorations lost his instrument, with 3300 fathoms of line out.

These Gulf Stream explorations were undoubtedly the first systematic deep sea explorations ever undertaken.

Our principal object, however, is to notice those great depths where *no bottom was found*, and to examine whether the failure *to find the bottom* was, under the circumstances, any proof that it did not exist at much less depths than those reported, or whether any conclusion whatever can be derived from the results.

When we reflect that two-thirds of the earth's surface is covered with water, while the remaining third is dry land; and that the figure of the solid part can only be known when we can trace with certainty the mountain ranges and valleys along the bottom of the sea, it becomes important to scrutinize those reported measurements which give such enormous depressions in different parts of the sea, compared with which the highest mountain ranges are insignificant elevations. Numerous instances have been reported in which soundings have been made to the depth of five, six, seven, eight and nine miles without finding bottom; and again over large areas the bottom of the sea is represented as a comparatively level plain submerged to the depth of two, three or four miles. Supposing these reported measurements to have been correct, we would have, still, very insufficient data for arriving at any correct conclusions with regard to the elevations and depressions of the ocean bed. What idea could be formed, for instance, of the topography of our country, if our knowledge of its surface consisted in knowing the height, above the level of the sea, of only one point in every

to develop interesting facts in regard to them, some of which might prove of importance to navigators, as all would be to general science. Professor J. W. Bailey, of West Point, kindly commenced an examination of this sort. 'All the deep-sea soundings,' he says, (in a letter to me on this subject.) are of the highest interest, being filled with organisms, particularly the calcareous Polythalamia, to an amount that is really amazing—hundreds of millions existing in every cubic inch of these green muds.

"'The most interesting specimen is the one labelled No. 1, latitude 38° 04′ 40″, longitude 73° 56′ 47″, 90 fathoms. This is crowded with Polythalamian forms, *mostly large enough to be recognized by a practised eye without the aid of a magnifier.*' A figure, or specimen which would enable a practised eye to recognize these forms—and Professor Bailey has promised to illustrate these researches by drawings—would render even this first inspection of practical value; the large Textularia, having the form of a *truncated pyramid*, which characterizes No. 8, latitude 39° 31′, longitude 72° 11′ 20″, 89 fathoms, not being mistakable for the forms abundant in No. 1,' it is to be hoped that Professor Bailey will carry so promising a subject to a conclusion. He may add another to the aids furnished by sceince to navigation."

State of the Union. Such points, selected at random, might be the highest or lowest points within an area of some thousands of square miles; and after all, we would only know that it was possible to measure those heights, without being able to conjecture, even, their relation to each other. In the case of deep-sea soundings, we only know that bottom has been reached; in some instances at depths which show that our ideas concerning the unfathomable abysses of the ocean have been erroneous, and to sustain the belief that the mean depth is less than has been supposed. With regard to the uncertainties of the measurements, it is not sufficient to say that, compared with the immense area over which they are spread, the depths are very small; it might as well be argued that the height of the Alps is insignificant compared with the distance around the earth, and therefore an error in height of one or two miles is unimportant: or that the elevations of ordinary mountain ranges need not be noticed when compared with the area of a continent. We are dealing with finite quantities not with the infinite with which they may be compared; and an error of several thousand feet in two or three miles is hardly within the limits of scientific accuracy.

Prominent among the instances of these reported unfathomable depths, stands the sounding of Captain Denham of the British Navy, in H. M. S. Herald, made in October, 1852, on a voyage from Rio de Janeiro to the Cape of Good Hope. This is an extreme case, but since it is reported among the greatest deep-sea casts, it will serve best for illustration.* *All other great casts of the lead which have been reported are subject to the same causes of error*, which are to be found in this, some in a greater and some in a less degree; so that it is not necessary for us to believe, yet, any thing with regard to them, except that they gave no result. The sounding of Captain Denham was made with a lead weighing nine pounds, attached to a line one-tenth of an inch in diameter; and it is reported that this lead descended to the depth of nearly nine miles in the sea without touching bottom.

In accordance with a plan which originated with the lamented G. M. Bache, United States Navy, in 1846, in the explorations of the Gulf Stream, and which has constantly been followed since Captain Denham noted the time of running out of the successive portions of the sounding line during the nine hours of its supposed descent. According to these observed times of descent the nine pound lead communicated to the descending line at the depth of 3,000 fathoms or 18,000 feet a velocity of *two feet* per second; a result which is *philosophically impossible*, since the re-

* Lieut. Maury discusses these deep casts in his sailing directions, but his rules for arriving at the depth do not seem to me to be entirely satisfactory.

sistance of the water acting upon a line of this diameter, moving with a velocity of two feet per second, at the depth mentioned, amounts to more than three times the weight of the lead or shot used. It will hardly be necessary to enter into any argument to show that there can be no motion of descent, when the resistance to that motion is three times the weight of the moving mass. Further, the observations show that the nine pound shot and line were running with a velocity of two feet and a half per second at the depth of 2,000 fathoms or 12,000 feet. Here the result contradicts in quite as strong a manner the mechanical laws of the descent; and in fact below 1000 fathoms or 6000 feet, if we credit the observations, a velocity was observed in the running out of the line which it was impossible for the lead to communicate to it. In fact but a small part of that velocity could have been produced by the descent of the lead. Here we have a reliable result to the depth of 1,000 fathoms only. The difference between this result and the conclusions of Captaim Denham is simply the difference between *one mile* and *nine miles.*

In measuring the distance to the sun an error of eight miles would hardly be worth noticing, perhaps, but what conclusions can be drawn from a measurement in which the probable error amounts to eight times the whole distance?

Popular ideas with regard to the sinking of bodies in the sea, have heretofore been vague; for the reason, perhaps, that the laws which govern this descent, and which are derived from the well known laws of fluids, have never been fully defined in their application to the depths of the ocean. Some imagine that ships which founder at sea, sink to a certain depth, and there float about until broken to pieces, or thrown upon some bank beneath the sea; and, indeed, a recent writer in England has published a book sustaining this absurd notion. Others again believe that the buoyant force of the water at great depths is enormous, and due to the whole pressure of the column of water above, and that all bodies which are lighter than water at the surface, will, if sunk to the bottom and detached from the sinker, shoot upward with a great velocity; or, in other words, that the *density* of the water increases directly with the depth. These views are erroneous. It is true the pressure increases with the depth, to the amount of fifteen pounds upon every square inch, for every thirty-four feet in depth; but the density is not thereby sensibly increased, owing to the incompressibility of the water; so that neither the buoyant force, nor the resistance to the motion of any body, are sensibly increased from the surface to the bottom. At the depth of 3000 fathoms, for instance, the pressure upon a square inch is nearly 8000 pounds, but the column of 18000 feet of water, is only shortened about 60 feet; the density is thus but slightly increased; but the effect of this enormous

pressure upon compressible bodies, as air, wood, &c., is to condense them into a smaller bulk, by which they may be rendered *heavier than water*, and will sink of their own weight. A piece of wood cannot float at the bottom of the sea, but a very slight extraneous force will bring it to the surface.

Now, how is it with the sounding lead and line? The lead, if allowed to descend alone, will fall with a uniform and rapid velocity to the bottom. This velocity will be attained within a few feet of the surface, and will be due to the opposing forces of gravity and the resistance of the water, which will be balanced, when the uniform velocity is reached. But if a line be attached to the lead, a few hundred feet of the line will offer a resistance to the motion nearly equal to the whole weight of the lead, and as successive lengths of line are drawn into the water, the resistance is constantly increased; so that at 2000 or 3000 fathoms depth, the weight will be almost entirely suspended in the sea by the resistance of the water along the sides of the line.

Some idea of the resistance which opposes the motion of a sounding line, may be formed from the fact that upon 1000 fathoms of a line one-tenth of an inch in diameter, moving with a velocity of three feet per second, the resistance is between twenty-five and thirty pounds. And if the velocity be increased to six feet per second, the resistance upon the line becomes an hundred pounds, nearly. Or, if the length of the line be doubled, with the same velocity, the resistance is doubled; and it is also directly proportional to the diameter of the line.

These are some of the reasons why an improvement in the mode of measuring the depths of the sea, is not only desirable, but necessary, before a certain knowledge of those depths can be obtained.

Art. XLV.—*Application of Polarized Light to the Microscope;* by Dr. M. C. White.

For conducting microscopic investigations with polarized light, it is customary to employ two Nicol's prisms, one of which is placed below the stage of the microscope, and the other just above the object-glass. If the prism placed below the stage is large a fine illumination is obtained by light reflected from a concave mirror placed below the prism, or by condensing the light, after it passes the prism, by means of an achromatic condenser. But as the Nichol's prism transmits only the extraordinary ray, produced by double refraction of the Iceland spar of which it is composed, one-half the light is lost and a powerful light is required to give adequate illumination.

The Nicol's prism above the object-glass, used for an analyser, requires to be large, otherwise the lateral portions of each pencil of light are cut off, the object seen in the microscope appears insufficiently illuminated, and the definition becomes very imperfect.

On the other hand, if the Nicol's prism is very large its length is increased in the same proportion as the breadth, and considerable aberration is produced by transmitting the pencil of light through so great a thickness of Iceland spar. A lateral displacement takes place equal to about one twelfth of the length of the Nicol's prism through which the light is transmitted.

These errors may be corrected and the definition of delicate objects greatly improved by placing another prism, exactly like the first, above it in the body of the microscope below the eye-piece, with its plane of principal section rotated 180°. This corrects entirely the lateral displacement. The second prism in the body of the microscope may be simply a prism of Iceland spar of the same dimensions as the Nicol's prism used as an analyser. This prism of Iceland spar may be placed next above the object-glass, and the Nicol's prism, if sufficiently large, just below the eye-piece without altering the effect. To show the *important* value of this *compensating prism* in the body of the Microscope, I will describe the results obtained with this apparatus.

With J. & W. Grunow's microscope No. 4, and a polarizing prism two and three-tenths of an inch in thickness beneath the stage, mounted to be used either with or without an achromatic condenser, I placed in the body of the microscope above the object-glass a Nicol's prism for an analyser, measuring two and one-fifth inches in thickness, and a prism of Iceland spar of the same dimensions (obtained from Rossie, N. Y.) in a reversed position just below the eye-piece. With this arrangement, using an eighth inch objective made by J. & W. Grunow, I was able to see three sets of lines on the Navicula angulata clearly defined, and with a good light, I could also distinctly see the six sides of the little hexagons on the same specimens. These phenomena can be seen with either of the three eye-pieces belonging to the microscope, but the six sides of the hexagons are best seen with No. 2 or No. 3 eye-piece. Taking away the compensating prism of plain Iceland spar, and with the same arrangement in every other respect, at the utmost only two sets of lines were seen, and the hexagons appear only as black dots, the form of which could not be distinguished. These facts prove conclusively, as I think, the great value of the compensating prism here described, which has never before been applied to the microscope so far as my knowledge extends.

New Haven, Oct. 1, 1858.

Art. XLVI.—*Correspondence of M. Jerome Nicklès, dated Paris, August 29th*, 1858.

Biographical Notices.—On the records of the same year, appears the death in France of two men of the same name, both of the great class of unfortunate inventors, and victims of their scientific zeal and devotion :—one, Louis Frederic Sauvage, the inventor of the screw used in navigation ; the other, Alexis Sauvage, inventor of the method of supplying steamboats with pure water by continued distillation. Although one in name, there was no family relation between them.

Frederic Sauvage was born in Boulogne sur Mer, September 19, 1785. He was at first employed in the department of military engineering. In 1811, he became naval constructor ; and a fact is mentioned of him, that attests to his probity in his profession. A French Company engaged him to construct steamboats to run between Boulogne and London. After examining the plans, and finding that they were faulty, Sauvage made some statements that were not well received. Notwithstanding the great remuneration which the work promised, he took his discharge from the company, unable, he said, to undertake to construct vessels that could not be navigated without endangering the lives of those aboard.

With principles so strict, it was difficult for Sauvage to succeed, and in fact, he had soon to give up his profession.

In 1821, he made arrangements at the quarry of Ellingen, for sawing and polishing marble by means of a horizontal mill of his own construction. About the same time he invented the *Physionometer*, a machine which afforded the statuary an easy and accurate means of taking moulds of objects in relief, and then obtaining an exact reproduction of the original. The machine afterwards applied by two speculators, under the name of the Physionotype, became to them a fortune ; but to the inventor a source of disappointment and chagrin.

In the midst of these disappointments, Sauvage took up the problem of the use of the screw in navigation, demonstrated its feasibility by means of a small model, and worked out its proportions and the best position for applying it. But all this was insufficient to bring it into favor ; as usual, it was also demanded of the inventor, after all his sacrifices, to make a trial on a large scale. Sauvage for ten years contended against the indifference of the government and the public. His propeller, finally, after being rejected in France, was adopted in England. It was now thought that the day of reparation had come. He was in prison for debts incurred in perfecting his invention, when the news reached him of the launching of the first French screw-propeller. An arrangement of the screw had been employed different from the plan of the inventor, and it worked poorly ; it was however afterwards perfected. But by this time the patent of Sauvage had become public property, and he received nothing.

Enfeebled by his sufferings, and discouraged by so much injustice, the poor inventor lost his reason. He died at an Insane Retreat, in July of 1857, after a confinement there of twelve years.

Two inventions, due to F. Sauvage, are still in use. The first, dating from 1836, is the *Reducer*, a kind of pantograph for the sculptor, em-

ployed for reducing work in high relief. This valuable instrument has been the means of furnishing, at small cost, multitudes of copies of the best works in statuary. This process, still employed by Mr. Henry Sauvage, the son of the inventor, is now used at the Louvre, and ought soon to supply all the academies and schools with a collection of fine models.

The *hydraulic bellows*, by which water may be raised to a height determined by the weight of the column of water, was the last invention of Frederic Sauvage. This machine is applicable to a multitude of uses, and may replace with economy the pumps used for irrigation and fire-engines.

As observed above, the life of Alexis Sauvage was much like that of Frederic, and before speaking of his works, we may relate briefly his history.

Alexis Sauvage was born in 1781, near Paris, of parents who were common laborers. Without home resources, he had only his skill and his knowledge to rely upon. By ardent application, he rapidly familiarized himself with mechanical science; and his example may be an encouragement to the young without means, showing what may be accomplished by perseverance and study.

Alexis Sauvage entered as apprentice at Bellevue, in the manufactory of the locksmith, Gamin, who gave lessons, as is known, to Louis XVI. Becoming well versed in his profession, he was afterwards employed as a mechanic in the government workshops.

In 1816, when illumination by gas was introduced into Paris, Sauvage, after taking an active part in the operations which decided the adoption of this mode of lighting, brought into use a method of illuminating panoramas. The government of Louis XVIII. having taken this invention under its own control, a company was formed in 1822 under the auspices of the King, with the aid of Chaptal and other scientific notabilities. Sauvage was made superintendent of the illumination of Paris and the royal theatres. In this position, he rendered very great service to the new industry. To him, we owe the first method of controlling the distribution and consumption of gas, and in particular the registration of the burners, and the application on a large scale of gas metres.

Among the inventions of Mr. Sauvage connected with this subject, are, the porcelain tubes, called gas candles, a mode of imitating the sunlight by means of gas in the scenery of the theatre, and the arrangement for lowering or raising the light in public halls.

After 1830, the union of the French and English Gas Companies led to a sad change in the position of Alexis Sauvage, for he was deprived of his place as Superintendent of the Paris works. He then applied himself to other departments of the industrial arts. He took up the manufacture of beet sugar, and invented that magnificent apparatus, (Sauvage's apparatus) for evaporating the saccharine juices in a vacuum. He was also the first who undertook in France, and successfully, the construction of the steam-heating apparatus; and who conceived and executed the Telescope Gasometer, and mounted them in many gas works.

But the scientific and industrial subject which most engaged his thoughts, was the continued supply of water to steam boilers by using the water distilled in the action of the engine. The problem occupied

him till his death, and he had the happiness of success on a small scale. The method now waits only to be established in confidence by a trial in the large way.

During his life of labor, filled with privations and mortifications, Alexis Sauvage met with a severe accident. In 1849, he was badly injured by the explosion of the Telescope Gasometer at the Opera. In the midst of the general fright, he did not hesitate to face the flames, and, at the peril of his life, go and close the valves of the gasometer; he thus saved from immediate destruction a quarter of Paris, as also the whole equipment of the theatre. The horrible burns he then got led him prematurely to the grave. And how did the English Gas Company manifest their gratitude towards one rendered infirm in their service? Did it not at least assure him of bread for the rest of his life? They ordered him a bronze medal and let him go to the hospital.

Incapable of work, and failing to obtain justice, Mr. Sauvage applied to the courts; and it was not until six years had passed, in 1855, that the English Company was condemned to pay a pension for his support of 1200 francs.

After this great disaster by fire, Alexis Sauvage never recovered his health; but he still held firm to hope and his moral energy. A medal of the second class was given him by the Jury at the "Exposition Universelle," in 1855; and efforts were made to secure him the means of carrying out, on a large scale, his system of condensation. But the unhappy inventor was not permitted to see it accomplished. His old wounds reopened, and he died of gangrene.

In deference to the last wish of A. Sauvage, his son and some of his friends have taken it upon them to give to humanity the benefit of the important modification of the steam engine invented by him. An engine of this kind, of ten-horse power, is now constructing at Paris. No other interest but that of the public good, actuates those engaged in it, as the invention of Sauvage long since became public property. We take this opportunity of giving some account of his plan.

Feeding of Steam Boilers with a continued supply of pure water.—The inconveniences due to supplying steam boilers with common water, constantly renewed, are well known, in the thick incrustations which cause the burning of the iron shell of the boiler, the waste of fuel, and the larger number of explosions. In marine boilers, all these inconveniences are experienced with greatly increased force. The invention of Alexis Sauvage, is designed to avoid these evils, by feeding the boiler solely with pure water. Watt's plan for this purpose, engaged the attention of Mr. S. Hall, a builder of engines in England, who in vain endeavored to supply distilled water from the exhausted steam. Sauvage has been more fortunate in his efforts to secure the same end, and by the use of the apparatus he has invented, he not only secures the continuous feeding of the boiler with pure water, but he has also been able to dispense with the air-pump in the condensing engine, and in the high pressure engine to obtain a considerable increase of power. It would be difficult to give the details of the condensing apparatus here, but we may be able from the plans before us to convey a general idea of the system. The condensing apparatus consists essentially, for station-

ary engines, of a series of parallel straight tubes, surrounded by cold water on their outside to determine the liquefaction of the vapor; and the heat given up to the condensing water is also availed of in part in feeding the boiler.

In steamboats, the condensation acts in a still more simple manner. Four openings are provided in the hull of the ship on each side of the keel, two forward and two aft, covered and connected respectively by large copper tubes, open at t'e ends to allow the free circulation of water, when the vessel is in motion. These openings are controlled by large stopcocks. If within these large tubes, one or more condensing tubes are extended, the liquefaction of the steam is effected freely, and without the need of any mechanism, or the consumption of any power. The system of Alexis Sauvage, for feeding steam boilers with condensed vapor, claims the following advantages:

1st, An increase of power in all engines, and especially in high pressure engines.

2d, A simplification of the condensing engine.

3d, Diminished consumption of fuel, due, (1) to the use of water at 35° to 40° C. (=95° to 104° F.); (2) to the absence of solid or muddy incrustations in the boiler; (3) to the absence of foam or spray in the steam from pure water, giving dry steam, or steam free from water mechanically suspended, (4) to the absence of any necessity for stopping to clean out the boiler.

4th, The preservation of the boiler from the injuries resulting from the mechanical operation of removing the deposits, and above all, from all danger of bruising the iron.

[It is but just to an ingenious American inventor, Mr. Stephen A. Gold, to say that he many years since constructed a steamboat for ocean navigation, in which the condensation of the steam was effected in a hollow metal keel, with perfect success.—Eds.]

Electric Telegraph.—The Academy of Sciences has recently had under discussion the question whether the passage of an electric wire near a magazine of powder, would be a source of danger. It was referred to a Commission, who have reported as follows:

The Commission consider it certain that the currents used for telegraphing along the wires, can never cause accident. For if broken by the wind, or otherwise, the small spark that might be produced would not even kindle the floating dust deposited on the wire or their supports. But it is different with atmospheric electricity, which may be of great power, and serious in its consequences, if a powder magazine were near by. A stroke of lightning might fuse the wire for some length, and throw the melted globules to a considerable distance, and farther still, with the aid of the wind. Besides, the inflamed ends of the wire could not fail to describe a large area, and carry far the fire.

For security, the Commission propose,

1st, To substitute subterranean wires for the aerial, whenever it runs within a hundred yards of a powder magazine.

2d, To put subterranean wires far enough from the magazine to render it safe for workmen to construct them or to examine and repair them.

3d, To set up several lightning rods on poles 15 to 20 yards high, in the vicinity of these subterranean wires, in order to protect from the direct action of lightning.

Photography—Sensitiveness of Photographic Reagents.—The sensitiveness of the reagents used in photography, is well known. But there are others more sensitive still, which often interfere with photographic results. Photographers are aware that they do not succeed well in the vicinity of a perfumery, and that even the effluvia from the hand that has been wet with an essence, will prevent success when it was thought to be sure. It has even been supposed that in clear weather, when the atmosphere was full of vegetable emanations and vapors drawn from the soil by heat, photographs do not succeed as well, and that these influences must be avoided for the finest results. Evidently, the emanations from the soil and plants are themselves sensitive to the chemical rays, and more so than the photographic reagents, especially chlorid of silver, and hence as far as they are not destroyed, may monopolize the chemical action.

These thoughts are suggested by a fact recently made known by Mr. Ford. He had always had perfect success; but afterwards, in spite of all precaution, failed of good pictures. After long seeking the cause, he finally found that it was owing to his room being near a storehouse of "noir animal," for economical uses,—the effluvia was injurious to the photographic liquids, the principal of which were nitrate of silver, pyrogallic acid, and hyposulphite of soda. He moved to another place and had no more difficulty.

New Photographic process for the Printing of positive proofs.—A piece of sulphur is dissolved in sulphuret of carbon, in the proportions of twenty-five parts of the former to seventy-five of the latter, and the solution is then filtered. The solution in sufficient quantity is poured on the paper, which is shaken quickly in every direction, in order that it may spread equally, and crystals of opaque sulphur may not form. The paper thus prepared, is kept in the dark. At the required moment, the paper is put under an ordinary negative, and exposed to the light for twenty-five seconds to a minute, or five minutes on a dark day. When taken out, nothing is seen on the paper.

Nothing appears upon the surface of the paper when it is removed from the slide. It is then put over a mercury bath at the bottom of which are placed some grams of this metal. The sulphurized paper from the camera is then exposed at the distance of eight centimetres above the mercury, (which is heated meantime,) sustained on a frame of paper forming a cover to the bath, on the under side of which, with its face to the mercury, is the prepared paper. The vapor of mercury, combines with the portions of sulphur which have received the influence of the sun's rays, forming a yellowish brown sulphuret of mercury, which perfectly reproduces the details of the impression. The picture is then protected by a film of varnish-gum, or albumen, to preserve it.

This is the process of M. Salmon, of Chartres.

False Diamond.—In 1857, several men of science at Paris, were consulted respecting a stone of fine water, cut like the regent diamond, which had been offered to dealers as a diamond. Its characteristics proved it to be a topaz. The owner of it afterwards carried it to Vienna, where, according to a letter from Mr. Haidinger, it was also shown to be a topaz, both by its double refraction, hardness, etc. The owner had

asked some millions for his gem, and jewellers offered him but 250 francs, regarding it only as a matter of curiosity. It is to be hoped that it will not come again into market as a diamond.

Silk-Worms.—One of the most active and distinguished of the members of the society of acclimation, M. Guérin Mèneville, who has been especially interested in the introduction of new silk-worms, has just succeeded in acclimating in France a new silk-worm from China, where it lives in the varnish tree (*Aylanthus glandulosa*). The species is the true *Bombyx Cynthia* of Drury, (1773,) figured for the first time by Daubenton, Jr., in his colored plates which were published between 1760 and 1765, and raised for some centuries in China, where its silk clothes the people. Roxburgh, in 1804, supposed the *Eria* which is raised in British India, to be the same, and this confusion has continued till recently, so that the Eria, (or Arrindy-arria, as it is called in Hindoostan,) has gone by the name of *Bombyx Cynthia.* The Eria is a different species living on the Ricinus; and we have several times spoken of it.

The study of the species by Guérin Mèneville, has brought to light differences between the two in the cocoons and the habits of the worms. The cocoons carded give an excellent flock of silk which is used in China and Bengal for very firm tissues. The color of the silk is a fine flax gray; and cloths made of it are not injured by the rain, or oil, and wear long.

Now that the introduction of the silk-worm is accomplished, attention is turned to the extension of it industrially. Guérin Mèneville proposes for this end the making of plantations of Aylanthus, a tree that grows easily on poor soil; then to place the worms upon them in spring that were hatched in the month of May, and let them eat the leaves. Care should be taken to preserve them from the birds, which is easily done by an invalid workman incapable of other work, as has been the custom for centuries in China. At the end of June, the first crop may be gathered, and a second in August. The cocoons for reproduction should be preserved until the next May, which requires, as with the silk-worm of the Ricinus, and the Dipsacus Fullonum, special care in the winter.

Bibliography.

At HATCHETTE'S, *Rue Pierre Sarazin, Paris:*

E. DeWarren, *L'Inde Anglaise avant et apres l'insurrection de* 1857. 3d edition, 2 vols, in 12mo; 1858.—Mr. DeWarren has been in the service of the East India Company for twenty years, and speaks from actual sight. The first edition appeared twelve years since. The record of recent events have given it a new interest.

Blaise Pascal: *Oeuvres Complètes.* 2 vols, 12mo; 1858.—Blaise Pascal, the great philosopher, the great theologian, who at the age of thirty-three, made in mechanics and physics inventions enough to immortalize any man, died in 1657, at the age of thirty-nine. This edition is a republication of his works, both philosophical and scientific. The latter are found in the second volume, and include, besides others, Experiments on the Vacuum, Treatise on the Equilibrium of Liquids, Treatise on the Weight of Air, Arithmetical Machine, Treatise on Numerical Orders, Problems on the Cycloid, History of the Roulette, Treatise on the Arcs of Circles, etc.

CORTAMBERT: *Cours de Géographie.* 2d edition; 1857.—Mr. Cortambert is eminent in France, as an instructor in Geography; and his works have corresponding success. The first edition appeared two years since.

At BAILLIÈRE'S, *Paris:*

M. LECOQ: *Etudes sur la Géographie botanique de l'Europe et en particulier sur la végétation du plateau central de France.* T. ix, 1858; Paris.—The printing of this work began in 1854, and the last volume has just appeared. Thirty years of study and observation in Auvergne, are discussed from a geological and botanical point of view.

SCIENTIFIC INTELLIGENCE.

I. CHEMISTRY AND PHYSICS.

1. *On telescopes of silvered glass and mirrors with ellipsoidal and paraboloidal surfaces.*—FOUCAULT has communicated to the Academy of Sciences a memoir on the substitution of silvered glass for metallic alloys in the construction of reflecting telescopes, and on the possibility of producing surfaces of revolution which reflect parallel rays to a single focus. It may be reasonably doubted whether the author has gone beyond or even attained the results of Lassell, the Earl of Rosse, Nasmyth, and other English mechanical artists who have devoted themselves to this subject, but we shall, nevertheless, give his statements as we find them. Foucault, in the first place, remarks that the spherical surface itself is difficult to obtain with absolute accuracy. When a luminous point is placed in the centre of curvature of a concave mirror, the image of this point is usually surrounded by an aureole, the appearance of which indicates defects in the surface. The author remedies these defects by retouching the mirror in different parts until the image is free from faults. The spherical mirror is then converted into an ellipsoidal and finally into a paraboloidal mirror by successive processes of approximation. A luminous point placed at first in the centre of curvature is made gradually to approach the principal focus; the image of course recedes in the opposite direction. By means of an appropriate polisher, the figure of the mirror is corrected for each successive portion of the luminous point, until finally the aberration becomes invisible for parallel rays. A telescope constructed in this manner with a mirror 33 centimeters in diameter, and having a focal length of $2^{m}{\cdot}25$ the author succeeded in resolving the blue star of γ Andromedæ into two distinct points. This result had hitherto been obtained only by Struve with the large Pulkowa instrument.—*Comptes Rendus*, xlvii, 205.

2. *On the influence of temperature upon phosphorescence.*—E. BECQUEREL has found that the color of the light emitted by phosphorescent bodies depends upon the temperature. Thus sulphid of strontium obtained by the action of sulphur upon caustic strontia at 700° C. or 800° C. is luminous with a violet light at ordinary temperatures, but changes its tints when the temperature varies, and returns again to its original tint when the original temperature is restored. In the case of sulphid of strontium the colors diminish in refrangibility as the temperature rises, but the re-

verse is the case with some other substances. The different effects depend upon the particular molecular condition of each substance.—*Comptes Rendus*, xlvii, 105.

3. *Distinction and separation of arsenic from antimony and zinc.*—Bunsen finds that oxyd of antimony is most readily distinguished from antimonic acid and antimonate of antimony ($2SbO_4 = SbO_3 + SbO_5$) even after strong ignition by gentle heating with chlorhydric acid after addition of a little iodid of potassium. Under these circumstances oxyd of antimony is dissolved to a yellow liquid without separation of iodine; in the other two cases iodine is set free and remains dissolved in the iodid of potassium. Even when the quantity of antimonic acid does not exceed some hundredths of a milligramme the solution gives a violet-blue or amethyst-red color when shaken with a few drops of bisulphid of carbon. The arsenic and antimony spots obtained in Marsh's process are easily distinguished by the following method. The spot is to be treated with enough nitric acid of density 1·42 to moisten it, and then gently heated till it vanishes. The porcelain plate is to be gently heated over a lamp while the operator blows strongly upon the moistened spot until the acid is completely evaporated without boiling. A drop of the ammonia-nitrate of silver will now produce a dark spot of suboxyd of silver if the white tache contains antimony. When, however, arsenic is present, the well-known yellow or brown-red precipitate is obtained, according to the duration of the action of the nitric acid, which may produce either arsenous or arsenic acid. In estimating antimony qualitatively Bunsen converts the precipitated sulphid into Sb_2O_3 by heating it in a porcelain crucible with a concave cover with fuming nitric acid. The boiling point of this acid is 86°, and therefore lower than the melting point of sulphur. The sulphur of the sulphid is therefore separated as a fine powder, and oxydizes easily and completely when the acid is evaporated in a water bath. The white residual mass gives on ignition pure Sb_2O_3. As the sulphid of antimony often ignites with fuming nitric acid, it may be previously moistened with acid of density of 1·42. Another method consists in igniting the sulphid of antimony with 30–40 times its weight of oxyd of mercury in a porcelain crucible, or better, in a platinum crucible lined with glass. For the precautions to be taken in using this method we would refer to the original memoir. Bunsen finds that bisulphite of potash dissolves sulphid of arsenic, but not the sulphids of tin and antimony. To separate arsenic from the other two metals he recommends adding a large excess of an aqueous solution of sulphurous acid to the solution of the three sulphids in sulphid of potassium. The liquid is to be digested in a water-bath, and then boiled until two-thirds of the water and all the sulphurous acid is driven off. The filtrate now contains all the arsenic as arsenous acid, while the mass on the filter is entirely free from arsenic.—*Ann. de Chemie und Pharm.*, cvi, 1.

4. *On the separation of alumina from iron.*—Chancel has observed that when a solution of hyposulphite of soda is added to one of a persalt of iron, the whole of the iron is reduced to the form of protoxyd, and remains in solution in the form of a double hyposulphite of soda and iron. On the other hand, weak bases, such as alumina and sesquioxyd of chromium, form extremely unstable compounds with hyposulphurous acid.

When hyposulphite of soda is added to a solution of alum as nearly neutral as possible, no precipitate is produced, but on heating to 60° C. or 70° C., sulphurous acid is disengaged, and alumina mixed with free sulphur precipitated, the reaction being expressed by the equation

$$Al_2O_3, 3SO_3 + 3(Na\,O, S_2O_2) = Al_2O_3 + 3S + 3SO_2 + 3(Na\,O, SO_3).$$

To render the precipitation complete, the solution containing the alumina must be very dilute, and must be boiled to expel sulphurous acid. For the separation of iron and alumina the author recommends the following process. The sulphuric or chlorhydric solution of alumina and iron is to be saturated with carbonate of soda until very nearly neutral, and water added till the liquid contains not more than 1 decigramme of alumina in 50 cubic centimeters. To this solution, which must be cold, a slight excess of hyposulphite of soda is to be added, and the whole allowed to stand until the liquid becomes completely decolorized. The liquid is then to be boiled until sulphurous acid is no longer disengaged. The precipitate of alumina and sulphur is to be filtered and washed with boiling water. The alumina is not gelatinous, but very compact, and may be washed with great ease. The ignition must, of course, take place in a porcelain crucible; the alumina obtained is perfectly white. The filtrate from the alumina contains all the iron. It is to be evaporated and treated with excess of chlorhydric acid and with chlorate of potash, diluted with water, filtered from the separated sulphur, and the iron precipitated by ammonia. The author asserts that the separation is exact in all cases.—*Comptes Rendus*, xlvi, 987.

[Note.—It would doubtless be much simpler to pass chlorine gas through the solution containing the iron after the separation of the alumina. The hyposulphurous acid would be thus directly converted into sulphuric acid, and the iron peroxydized.—W. G.]

5. *On the preparation of Calcium.*—Liès Bodart and Gobin have communicated to the Academy of Sciences a note on the preparation of calcium which is of much interest. The author found it impossible to obtain the metal by the action of sodium upon chlorid of calcium at a high temperature, but the reduction succeeds extremely well when the iodid is employed instead of the chlorid. The iodid of calcium was obtained by the action of iodhydric acid upon white marble, evaporating the solution and fusing the salt out of contact of air; as thus prepared it resembles chlorid of magnesium. Equal equivalents of sodium and iodid of calcium are to be mixed and gradually heated in a covered iron crucible to a strong red but not to a white-red heat. After an hour the crucible is to be removed from the fire and allowed to cool. In this manner the author obtained a button of calcium weighing about three grammes by employing four grammes of sodium. The metal was pale yellow with a reddish reflection, and proved on analyses to be pure. The authors promise more ample details with respect to the properties of calcium, as well as a notice of their results in reducing barium and strontium by a similar process.—*Comptes Rendus*, xlvii, 23.

6. *New mode of preparing propionic acid.*—Wanklyn has prepared propionic acid by the action of carbonic acid gas upon sodium-ethyl. When zinc-ethyl is heated with sodium, zinc is precipitated, and a crys-

talline compound containing zinc-ethyl and sodium-ethyl formed. This compound is soluble in excess of zinc-ethyl, and on transmitting a current of carbonic acid over it, great heat is evolved; zinc-ethyl distils off and the contents of the bulb form an amorphous white solid. This solid consists principally of propionate of soda, the reaction being expressed by the equation

$$C_2O_4 + NaCuH_5 = C_6H_5NaO_4.$$

In this manner we have a synthesis corresponding to the well-known analysis of the fatty acids made some years since by Kolbe.—*Quart. Jour. Chem. Soc., No.* xlii, 103.

7. *Purification of hydrogen and carbonic acid.*—STENHOUSE has given a very simple and useful method of removing the offensive odor from hydrogen gas prepared from commercial materials. This consists in passing the gas through a layer of coarsely powdered wood-charcoal which absorbs the impurities so that the gas completely loses its odor. The same process may be applied to the purification of carbonic acid gas as evolved by acids from marble or limestone containing organic matter.—*Ann. der Chemie und Pharm.*, cvi, 125.

8. *On the fusion of molybdenum.*—DEBRAY finds that pure metallic molybdenum completely withstands the temperature at which platinum, quartz, &c., become liquid. The metal melts in a crucible of carbon before the oxyhydrogen blowpipe at a temperature at which rhodium fuses, but the fused mass contains 4·5 per cent of carbon. It has a silvery lustre and scratches glass and topaz with ease. Tungsten appears to be even less fusible.—*Comptes Rendus*, xlvi, 1098. W. G.

9. *Crystallization of various Salts.*—A long and able paper on the crystalline form and angles of various artificial salts, by *Marignac*, is published in the Annales des Mines, vol. xii, 5th series, (1857,) pages 1–74. Upwards of 50 species of salts are crystallographically described.

10. *On some properties of Ice near its Melting Point;* by Prof. FORBES, (Proc. Roy. Soc. Edinb., cited from Phil. Jour., vol. viii, No. 1, p. 150.)—"During the last month of March, I made some experiments on the properties of ice near its melting point, with particular reference to those of Mr. Faraday, published in the 'Athenæum' and 'Literary Gazette' for June, 1850, to which attention has been more lately called by Dr. Tyndall and Mr. Huxley in relation to the phenomena of glaciers.

Owing to indisposition, I have been obliged to leave my experiments for the present incomplete. But I am desirous, before the session of the Royal Society closes, to place on record some facts which I have observed, and also some conclusions which I deduce from these and other recent experiments and discussions.

Mr. Faraday's chief fact, to which the term 'regelation' has been more lately applied, is this, that pieces of ice, in a medium above 32°, when closely applied, freeze together; and flannel adheres apparently by congealing to ice under the same circumstances.

1. These observations I have confirmed. But I have also found that metals become frozen to ice when they are surrounded by it, or when they are otherwise prevented from transmitting heat too abundantly. Thus, a pile of shillings being laid on a piece of ice in a warm room,

the lowest shilling, after becoming sunk in the ice, was found firmly attached to it.

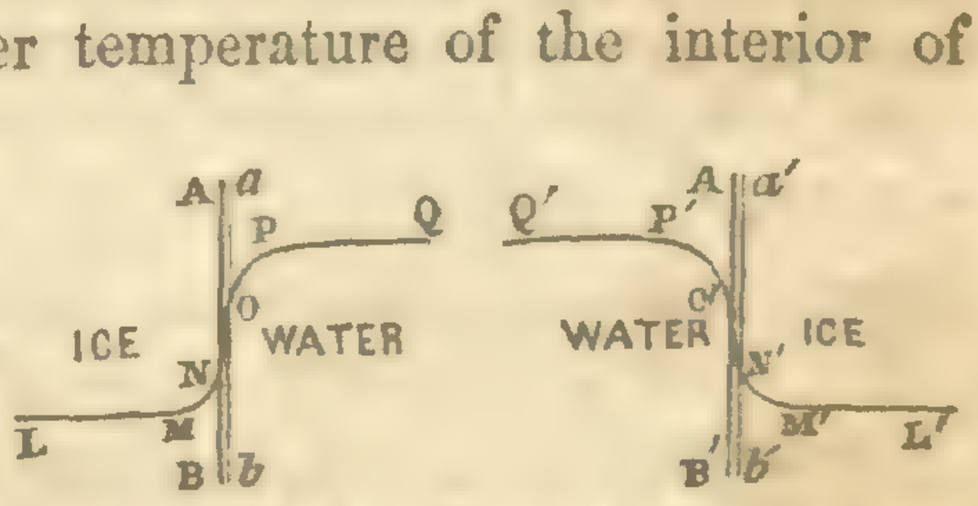
2. Mere *contact*, without *pressure*, is sufficient to produce these effects. Two slabs of ice, having their corresponding surfaces ground tolerably flat, were suspended in an inhabited room upon a horizontal glass rod passing through two holes in the plates of ice, so that the plane of the plates was vertical. Contact of the even surfaces was obtained by means of two very weak pieces of watch-spring. In an hour and a half the cohesion was so complete, that, when violently broken in pieces, many portions of the plates (which had each a surface of twenty or more square inches) continued united. In fact, it appeared as complete as in another experiment where similar surfaces were pressed together by weights. I conclude that the effect of pressure in assisting 'regelation,' is principally or solely due to the larger surfaces of contact obtained by the moulding of the surfaces to one another.

3. Masses of strong ice, which had already for a long time been floating in unfrozen water-casks, or kept for days in a thawing state, being rapidly pounded, showed a temperature 0°·3 Fahrenheit below the true freezing point, indicated by delicate thermometers (both of mercury and alcohol,) carefully tested by long immersions in a considerable mass of pounded ice or snow in a thawing state.

4. Water being carefully frozen into a cylinder several inches long, with the bulb of a thermometer in its axis, and the cylinder being then gradually thawed, or allowed to lie for a considerable time in pounded ice at a thawing temperature, showed also a temperature decidedly inferior to 32°, not less, I think, than 0°·35 Fahrenheit.

I think that the preceding results are all explicable on the one admission, that Person's view of the gradual liquefaction of ice is correct (*Comptes Rendus*, 1850, vol. xxx, p. 526*). or that ice gradually absorbs latent heat from a point very sensibly lower than the zero of the centigrade scale.

I. This explains the permanent lower temperature of the interior of ice.



Let AB be the surface of a block of ice contained in water at what is called a freezing temperature. That temperature is marked by the level of the line QP above some arbitrary zero. LM is, in like manner, the permanent but somewhat lower temperature possessed by the interior of the ice. The space, partly water, partly ice, or partaking of the nature of each, MNOP, has a temperature which varies from point to point, the portion NO corresponding to what may be called the physical surface of the ice between AB and *ab*, which is 'plastic ice,' or 'viscid water,' having the most rapid variation of local temperature.

II. Such a state of temperature, though it is in one sense permanent, is so by compensation of effects. Bodies of different temperatures cannot continue so without interaction. The water *must* give off heat to the ice, but it spends it in an insignificant thaw at the surface, *which therefore*

* Quoted by me in 1851, in my sixteenth letter on Glaciers.

wastes, even though the water be what is called ice cold, or having the temperature of a body of water enclosed in a cavity of ice.*

This waste has yet to be proved; but I have little doubt of it; and it is confirmed by the wasting action of superficial streams on the ice of glaciers, though other circumstances may also contribute to this effect.

III. The theory explains 'regelation.' For let a second plane surface of ice A′B′ be brought up to nearly physical contact with the first surface AB. There is a double film of 'viscid water' isolated between two ice surfaces colder than itself. The former equilibrium is now destroyed. The films AB*ba* and A′B′*b′a′* were kept in a liquid or semi-liquid state by the heat communicated to them by the perfect water beyond. That is now removed, and the film in question has ice colder than itself on both sides. Part of the sensible heat it possesses is given to the neighboring strata which have less heat than itself, and the intercepted film of water in the transition state becomes more or less perfect ice.

Even if the second surface be not of ice, provided it be a bad conductor, the effect is practically the same. For the film of water is robbed of its heat on one hand by the colder ice, and the other badly conducting surface cannot afford warmth enough to keep the water liquid.

This effect is well seen by the instant freezing of a piece of ice to a worsted glove, even when on a warm hand. But metals may act so, provided they are prevented from conveying heat by surrounding them with ice. Thus, as has been shown, metals adhere to melting ice."

II. GEOLOGY.

1. *Tertiary Basin of White and Niobrara Rivers;* by F. V. Hayden, M.D., (Proc. Acad. Nat. Sci., Philad. June, 1858).—In a former paper† I gave a vertical section of the different beds of this basin as far as they were known at that time. During the past year, many additional facts and a large collection of new organic remains have been secured, which enable me to present a section more accurate and complete. It will be at once apparent from the list of localities for the different beds, how extensive a geographical area this basin occupies.

Vertical Section, showing the order of superposition of the different beds of the Tertiary Basin of White and Niobrara Rivers.

Post-Pliocene.—Yellow silicious marl, similar in its character to the loess of the Rhine, passing down into variegated indurated clays and brown and yellow fine grits; contains remains of extinct quadrupeds,

* I incline to think that water, in these circumstances, may, though surrounded by ice, have a fixed temperature somewhat higher than what is called 32°. But I have not yet had an opportunity of verifying the conjecture.

[My idea is, that the invasion of cold from the surrounding ice is spent in producing a very gradual 'regelation' in the water which touches the ice, leaving the interior water in possession of its full dose of latent heat, and also of a temperature which may slightly exceed 32°. By similar reasoning, a small body of ice, inclosed in a large mass of water, will preserve its proper internal temperature *below* 32°; but, instead of regelation taking place, the surface is being gradually thawed. This is the case contemplated in the paragraph of the text to which this note refers.]

† Notes on the Geology of the Mauvaises Terres of White River, Proc. Acad. Nat. Sci., Philad. June, 1857.

The paper above cited from, is the same that is noticed on p. 276 of this volume.

mingled with those identical with recent ones; also a few Mollusca, mostly identical with recent species, so far as determined.

Most fully developed along the Missouri River, from the mouth of the Niobrara to St. Joseph; also in the Platte Valley and on the Loup Fork.

Thicknees, 300 to 500 feet.

Pliocene Tertiary.—Bed F.—1st, dark gray or brown sand, loose, incoherent, with remains of Mastodon, Elephant, &c.; 2d, sand and gravel, incoherent; 3d, yellowish white grit, with many calcareous, arenaceous concretions; 4th, gray sand with a greenish tinge; contains the greater part of the organic remains; 5th, deep yellowish red arenaceous marl; 6th, yellowish gray grit, sometimes quite calcareous, with numerous layers of concretionary limestone from two to six inches in thickness, containing fresh water and land shells, Succinea, Limnea, Paludina, Helix, &c., closely allied and perhaps identical with living species; also much wood of coniferous character.

Covers a very large area on Loup Fork, from the mouth of North Branch to source of Loup Fork; also in the Platte Valley. Most fully developed on the Niobrara River, extending from the mouth of Turtle River three hundred miles up the Niobrara. Also on Bijoux Hills and Medicine Hills. Thinly represented in the valley of White River.

Thickness, 300 to 400 feet.

Miocene.—Bed E.—Usually a coarse-grained sandstone, sometimes heavy bedded and compact; sometimes loose and incoherent; varies much in different localities. Forms immense masses of conglomerate; also contains layers of tabular limestone with indistinct organic remains; very few Mammalian remains detected, and those in a fragmentary condition. Passes gradually into the bed below.

Most fully developed along the upper portion of the Niobrara River, and in the region around Fort Laramie. Seen also on White River, and on Grindstone Hills.

Thickness, 180 to 200 feet.

Miocene.—Bed D.—A dull reddish brown indurated grit, with many layers of silico-calcareous concretions, sometimes forming a heavy bedded fine-grained sandstone; contains comparatively few organic remains.

Niobrara and Platte rivers: well developed in the region of Fort Laramie; also in the valley of White River. Conspicuous, and composing the main part of the dividing ridge between White and Niobrara rivers.

Thickness, 350 to 400 feet.

Bed C.—Very fine yellow calcareous sand, not differing very materially from Bed D, with numerous layers of concretions and rarely organic remains, passing down into a variegated bed, consisting of alternate layers of dark brown clay and light gray calcareous grit, forming bands, of which I counted twenty-seven at one locality, varying from one inch to two feet in thickness.

White River, Bear Creek, Ash Grove Spring, Head of Shyenne River. Most conspicuous near White River.

Thickness, 50 to 80 feet.

Miocene.—Turtle and Oreodon Bed, B.—A deep flesh-colored argillo-calcareous indurated grit; the outside when weathered has the appearance of a plastic clay. Passes down into a gray clay, with layers of

sandstone; underlaid by a flesh-colored argillo-calcareous stratum, containing a profusion of Mammalian and Chelonian remains. Turtle and Oreodon Bed.

Old Woman's Creek, a fork of Shyenne River; also on the head of the South Fork of the Shyenne; most conspicuous on Sage and Bear creeks, and at Ash Grove Spring. Well developed in numerous localities in the valley of White River.

Thickness, 80 to 100 feet.

Miocene.—Titanotherium, Bed A.—Light gray fine sand, with more or less calcareous matter, passing down into an ash-colored plastic clay, with large quantities of quartz grains disseminated through it, sometimes forming aggregated masses like quartzose sandstone cemented with plastic clay; then an ash-colored clay with a greenish tinge, underlaid at base by a light gray and ferruginous silicious sand and gravel, with pinkish bands. Immense quantities of silex in the form of seams all through the beds. Titanotherium Bed.

Old Woman's Creek; also in many localities along the valley of the South Fork of Shyenne, Best development on Sage and Bear Creeks. Seen at several localities in the valley of White River.

Thickness, 80 to 100 feet.

Cretaceous.—Nos. 4 and 5.—Cretaceous beds 5 and 4, with their usual lithological characters and fossils.

Exposed underneath the Tertiary Beds on the South Fork of Shyenne and its southern branches, also in White River Valley near its source.

Catalogue of all the Fossils hitherto described from the Tertiary Formations of White and Niobrara rivers, with a Table showing their stratigraphical position.

	Beds in Ascending order.					
RUMINANTIA.	A	B	C	D	E	F
1. Oreodon graciliis, *Leidy*	..	*	*	*	*	..
2. Oreodon Culberstoni, *Leidy*	..	*	*	*	..	..
3. Oreodon major, *Leidy*	..	*	..	*	..	..
4. Agriochœrus major, *Leidy*	..	*	..	*	..	..
5. Agriochœrus antiquus, *Leidy*	..	*	..	*	..	..
6. Poebrotherium Wilsoni, *Leidy*	..	*	..	..	..	..
7. Leptomeryx Evansi. *Leidy*	..	*	..	*	..	..
8. Leptauchenia decoran, *Leidy*	..	..	..	*	..	..
9. Leptauchenia major, *Leidy*	..	..	..	*	..	..
10. Protomeryx Halli, *Leidy*	..	..	..	*	..	..
11. Merycodus necatus, *Leidy*	..	..	..	..	..	*
12. Megalomeryx niobrarensis, *Leidy*	..	..	..	..	..	*
13. Merychochœrus proprius, *Leidy*	..	..	..	*	..	..
14. Procamelus occidentalis, *Leidy*	..	..	..	..	..	*
15. Procamelus robustus, *Leidy*	..	..	..	..	..	*
16. Procamelus gracilis, *Leidy*	..	..	..	..	..	*
17. Merychyus elegans, *Leidy*	..	..	..	..	..	*
18. Merychyus medius, *Leidy*	..	..	..	..	..	*
19. Merychyus major, *Leidy*	..	..	..	..	..	*
20. Cervus Warreni, *Leidy*	..	..	..	..	..	*

	Beds in Ascending order.					
	A	B	C	D	E	F
MULTUNGULA.						
21. Chœropotamus (Hyopotamus) Americanus, *Leidy*	*	..	..	..	..	..
22. Entelodon Mortoni, *Leidy*	..	*	..	*	..	..
23. Entelodon ingens, *Leidy*	..	*	..	*	..	..
24. Titanotherium Prouti, *Leidy*	*	..	..	..	..	..
26. Paleochœrus probus, *Leidy*	..	*	..	*	..	..
27. Leptochœrus spectabilis, *Leidy*	..	*	..	*	..	..
28. Rhinoceros occidentalis, *Leidy*	..	*	*	*	*	..
29. Rhinoceros (Hyracodon) nebrascenis, *Leidy*	..	*	*	*	*	..
30. Rhinoceros crassus, *Leidy*	..	..	..	..	..	*
31. Mastodon (Tetralophodon) merificus, *Leidy*	..	..	..	..	..	*
32. Elephas (Euelephas) imperator, *Leidy*	..	..	..	..	..	*
SOLIDUNGULA.						
33. Hipparion, s. Hippotherium occidentale, *Leidy*	..	..	..	..	..	*
34. Hipparion, s. Hippotherium speciosum, *Leidy*	..	..	..	..	..	*
35. Anchitherium Bairdi, *Leidy*	..	*	..	..	..	..
36. Anchitherium (Hypohippus) affinis, *Leidy*	..	..	..	*	..	..
37. Anchitherium (Parahippus) cognatus, *Leidy*	..	..	..	*	..	..
38. Merychippus insignis, *Leidy*	..	..	..	..	..	*
39. Merychippus mirabilis, *Leidy*	..	..	..	..	..	*
40. Equus excelsus, *Leidy*	..	..	..	..	..	*
41. Equus (Protohippus) perditus, *Leidy*	..	..	..	..	..	*
RODENTIA.						
42. Steneofiber nebrascensis, *Leidy*	..	..	*	*	..	..
43. Ischyromys typus, *Leidy*	..	..	*	*	..	..
44. Palæolagus Haydeni, *Leidy*	..	..	*	*	..	..
45. Eumys elegans, *Leidy*	..	*	..	..	..	..
46. Hystrix (Hystricops) venustus, *Leidy*	..	..	..	*	..	*
47. Castor (Eucastor) tortus, *Leidy*	..	..	..	..	..	*
CARNIVORA.						
48. Hyænodon horridus, *Leidy*	..	*	..	..	..	..
49. Hyænodon cruentus, *Leidy*	..	*	..	..	..	..
50. Hyænodon crucians, *Leidy*	..	*	..	..	..	..
51. Amphicyon vetus, *Leidy*	..	*	..	..	..	..
52. Amphicyon gracilis, *Leidy*	..	*	..	..	..	..
53. Leptarctus primus, *Leidy*	..	..	..	..	..	*
54. Deinictis felina, *Leidy*	..	*	..	..	..	..
55. Machærodus primævus, *Leidy*	..	*	..	..	..	..
56. Felis (Pseudœlurus) intrepidus, *Leidy*	..	..	..	..	..	*
57. Ælurodon ferox, *Leidy*	..	..	..	..	..	*
58. Canis sævus, *Leidy*	..	..	..	..	..	*
59. Canis temerarius, *Leidy*	..	..	..	..	..	*
60. Canis vafer, *Leidy*	..	..	..	..	..	*
61. Canis (Epicyon) Haydeni, *Leidy*	..	..	..	..	..	*

	Beds in Ascending order.					
	A	B	C	D	E	F
CHELONIA.						
62. Testudo nebrascensis, *Leidy*	..	*	*	*	*	..
63. Testudo (Stylemys) niobrarensis, *Leidy*	..	..	..	..	..	*
MOLLUSCA.						
64. Helix Leidyi, *Hall & Meek*	..	*	..	..	..	..
65. Planorbis nebrascensis, *Evans & Shumard*	..	..	..	*	..	..
66. Lymnea diaphana, *Evans & Shumard*	..	..	..	*	..	..
67. Lymnea nebrascensis, *Evans & Shumard*	..	..	..	*	..	..
68. Physa secalina, *Evans & Shumard*	..	..	..	*	..	..
CRUSTACEA.						
69. Cypris Leidyi, *Evans & Shumard*	..	..	..	*	..	..

2. *Letter from* G. Garcia Moreno, *to* Prof. W. Jameson, *relative to the Exploration of the Volcano of Pichincha*, dated Quito, 13th January, 1858, (cited from Edinb. New Phil. Jour., vol. vii, April, 1858.)—The following is a brief account of my last exploring expedition to the volcano which overlooks Quito. The short distance at which the volcano Rucu-Pichincha is situated from this city, has contributed to excite the curiosity of the scientific travellers who have visited the territory of the Ecuador, and have caused the state and form of the volcano to be well known. Bouguer and La Condamine, in 1742, were the first who reached the brink of the crater; the celebrated Alexander Humboldt, in May 1802, twice surmounted the gigantic wall of dolerite which forms the eastern border of the volcano; and about thirty years after, your countryman, the unfortunate Colonel Hall, and M. Boussingault, followed in the same path; but since 1844, in which M. Sebastin Wisse and I descended to explore it, no one had reached the bottom. In August 1845, we returned with the intention of making the topographical plan of the volcano, measuring heights, &c.; and in order that we might do this, we had to pass three days and three nights in the two deepest cavities which form Rucu-Pichincha.

In an orographical view, our second expedition gave us the results which we longed for. Rucu-Pichincha, placed to the S. W. of Quito, forms two great basins, one to the east of the other, 4921 English feet in length. The eastern basin, called, without sufficient reason, "Eastern Crater," has the form of a narrow valley, long and deep, through the middle of which passes from north to south a fissure which receives the rain and melted snow: there exists a slight depression in the upper part of this basin of an elliptical form, and perfectly horizontal at the bottom, similar in everything to a little alpine lake dried up by the action of the sun; a depression which at one time, from its form, gave rise to the belief in the existence of an inactive crater. The depth of this supposed crater is 1050 feet below the wall of eastern rocks; and as the highest of these reaches to 15,748 feet above the level of the sea, the height of the bottom of the eastern crater is 14,875 feet.

The western basin, or, more properly, the true crater of Pichincha, is one of the most imposing objects which is presented to naturalists—

placed on the western slope of Rucu-Pichincha, differing from the other craters of the Ecuador, which takes the form at the summit of a regular cone covered with snow, it presents the figure of a truncated cone placed upon its inferior base, which is 1476 feet in diameter, and rises in height to 2296 feet. Its depth from the eastern side is enormous; and gazing upon the immense towers of dolerite and trachyte elevated 2460 feet, sometimes vertically, sometimes in slopes more or less steep and varied, an impression is received which can never be effaced. Towards the western part, the height of the walls of the crater diminishes gradually, leaving open to the east a fissure from whence the united waters escape during the rains or thaws.

In the middle of the inclined plain which constitutes the bottom of the volcano, the actual cone of eruption rises; it is 820 feet in diameter, 262 in height above the bottom of the middle of the crater, and 13,707 above the level of the sea, standing 4166 feet above Quito. This little mountain is now the centre of volcanic activity in Pichincha, and presented in 1845 clear indications of remaining permanent many years without increase of intensity. A great part of this mountain is covered with vegetation; two regions, parting in opposite direction, completely gird it, until they are united in the cleft of which I have spoken; and in the two points from whence the cone of eruption is depressed (one to the centre, the other to the S.E.) there is given out in abundance a hot and sulphurous vapor which lines with sulphur the holes and interstices between the fragments of rock of which the cone is composed.

We failed, in the expedition of 1845, to study the volcanic and vegetable products which the crater presented. In order to examine its actual state, and to fill this blank, I descended on the 16th of last December, carrying, as far as possible, what was necessary for the perilous situations in which I expected to be placed. I was engaged little more than three hours in the descent; and half-past eleven of the day found me at the cone of eruption. The form which this presents, proves that the bottom of Pinchincha has been recently the theatre of considerable convulsions. The vegetation which covered it has disappeared from the eastern side; the depression which exists towards the southeast, at the foot of the cone, has widened itself, and has filled up a part of the broken inclosure, interrupting it perpendicularly with a broad wall of stones, undoubtedly shot out from its interior. Near to this, and towards the south, it has formed, since 1845, a new depression, or, speaking more properly, a new accidental crater, from whence arises a great mass of vapor, so that the cone of eruption has at present three apertures or craters: the principal occupying the higher part; the ancient accidental crater, placed at the southeast, and at the foot of the former; and the new accidental crater, open likewise at the foot and at the south of the principal one.

The volcanic activity of Pichincha has increased remarkably, as is manifested by the greater exhalation of vapors. In 1845, the chimneys from whence the gases arose formed six groups, of which only one was considerable. Now the vapors escape by innumerable interstices and hollows, which the stones leave in each of the craters; and in the princi-

pal one is heard a noise resembling that made by an immense cauldron of boiling water.

The temperature of the vapors varies much in the different interstices. In the crater of the southeast, the vapors of the highest interstices are nearly 188°·6 Fahr., whilst in the lower ones the temperature was only 140° Fahr. In the principal crater, the hottest vapors did not come up to 194° Fahr.; in the largest interstice that I have observed, into which a person could easily enter, if the thick column of vapor would permit him, the temperature was only 98·6° Fahr. at three feet of depth. Filling a graduated tube with water, and placing it within the interstices, I collected the gases several times in order to analyze them, and, moreover, condensed them by means of a bottle filled with cold water, and gathered the drops of fluid which were formed. The result of my observations is, that the gases of Pichincha contain a scarcely perceptible trace of sulphurous, sulphuric, and sulphydric acid, four per cent of carbonic acid, and the rest composed exclusively of water. I present these results only as approximate ones. The atmospheric air is always mixed with the volcanic gases in those points where it is possible to collect it; and this cause of error is inevitable, without reckoning those which occur from the personal difficulties of the observer.

The solid products of the volcano are the sublimed sulphur which covers almost all the stones and fissures; and a white salt which appears in silky fibres, and shows itself in many of the interstices, sometimes alternating with the flower of sulphur in parallel coatings, sometimes in an abundant and pure mass. This salt is a double sulphate of alum and of the protoxyd of iron, likewise formed in other volcanoes, and known by the name of "*alumbre de pluma*," or plumose alum. Dissolved in water, it crystallizes by spontaneous evaporation in a derivative form of the oblique rhomboidal prism. Besides these products, there is found scoria, composed of melted sulphur and ashes of pyroxene and dolerite, more or less calcined or altered by the action of the watery vapors.

The plants which I collected in the crater, and which you had the goodness to name, are: *Alchemilla nivalis*, *Ranunculus Gusmanni*, *Jamesonia* sp. (these two plants were found nowhere else but on the ridge of Pichincha); *Culcitium reflexum*, *Werneria graminifolia*; *Gaultheria myrsinoides* (the space of ground in which this little shrub grew, showed a high degree of temperature—87° Fahr.); *Polypodium crenulatum*, *Porerretia pyramidata*.

I came out of Pichincha on the 17th of December, after having passed the previous night within the crater, and at 493 feet from the cone of eruption. Desirous of continuing my observations, I retain the hope of returning to the crater in the present year, in order to pass some days within it; I consider my late expedition only as a preparatory and necessary step towards another more important one. Before undertaking it, I will ascertain the point from whence the descent to the bottom of Pichincha is likely to be easiest, avoiding the imminent peril of precipitating oneself when descending the eastern wall. In 1844, M. Wisse fortunately saved himself in time from rolling headlong into a horrible abyss. A similar accident befell me in 1845; and in December last year, your son, who accompanied me, nearly found his grave in the

abyss. I have no doubt that in descending 2460 feet of rocks, in which hands are more useful than feet, a single rash step would be followed by fatal consequences.

3. *Metamorphism*, (L'Institut, No. 1282, July, 1858.)—Deville impregnated a piece of chalk with chlorid of magnesium and then heated it for a long time in a platinum crucible in a sand-bath. By a temperature of about 100° C., six to seven per cent of lime were replaced by magnesia. Washing and repeating this eight times, the ratio of magnesia to the lime was 1 : 2, or nearly that of a true dolomite (which is 1 : $1\frac{1}{2}$).

In this reaction, however, some carbonic acid was given off and oxychlorid formed. But on exposing the piece in water to the atmosphere, a little pure carbonate of lime formed and separated with the chlorid and left a neutral dolomite. It was an unexpected result to find the carbonic acid of the atmosphere promoting this result, while a saturated solution of carbonic acid leads to the formation of bicarbonates.

Deville impregnated a sandstone which contained no lime with a mixed solution of chlorid of calcium and magnesium and submitted it to the action of a good red heat. After several repetitions of the process, the mass became spongy and more absorbent. Pulverized and raised to a white heat, it fused to a milk-white mass consisting of interlaced crystalline fibres. Its specific gravity was 3·0; it was not attacked by acids; it contained no chlorine, but consisted of

$\ddot{S}i$ 56·0 $\dot{C}a$ 26·3 $\dot{M}g$ 17·7

equivalent to $(\dot{C}a, \dot{M}g)^3\,\ddot{S}i^2$, or a variety of pyroxene.

4. *Diprotodon trilobus, a new fossil Marsupial in Australia.*—A new species of the marsupial genus Diprotodon, as large as an ox, has been found fossil at King's Creek, Darling Downs, in New South Wales. The skull is eighteen inches long, and fifteen wide where broadest, being very broad for its length. The species of Diprotodon before described has the skull proportionally narrower, it being about three feet long and one foot eight inches broad. It is called the *Zygomaturus trilobus* by Macleay of Australia; but according to Prof. Owen, the genus is probably not distinct from Diprotodon.

5. *Permian System of England.*—A paper on the rocks and fossils of the Permian of the counties of Durham and Northumberland, by R. House, is contained in the Annals and Magazine of Natural History, [2], vol. xix, (1857), pages 33, 304 and 463, and plate 4.

6. *Peak of Aconcagua.*—The height of the peak of Aconcagua in the Chilian Andes, according to the recent measurements of Mr. Pissis is 6,834 meters, 304 meters above Chimborazo. It was made 7,287 meters (23,910 feet) by Beechey and Fitzroy.

7. *Mastodon giganteus.*—A tooth of the Mastodon has been found near Morpeth, Canada West.

8. *Iowa Geological Report.*—We are authorized to state that this Report, by Prof. James Hall and J. D. Whitney, is nearly ready to be issued. The work is one of great interest in all its departments. It contains descriptions and plates of numerous fossils, and is exceedingly rich on the subject of Crinoids.

III. BOTANY AND ZOOLOGY.

1. Martius: *Flora Brasiliensis:* Fasc. 18, in two parts, 1857-8. Fasc. 19 & 20, 1857.—The 18th portion of this elaborate work is occupied with one of the larger tropical families, viz: the *Myrtaceæ*, and forms a goodly volume of 527 pages, illustrated by 82 plates. It also contains two lithographed views of Brazilian vegetation, and a fine map of almost all South America, exhibiting the routes of the principal botanical explorers, from Ruiz and Pavon, and Humboldt, down to Castelnau, Weddell, and Spruce. This will be very useful to botanists. The *Myrtaceæ* are elaborated by Otto Berg, a young Prussian Botanist, who has at the same time made a revision of all the known American plants of the order, in the Linnæa. He gives us no less than 51 genera, of which 42 occur in the Brazilian empire. The nature-printing process of Auer, is advantageously introduced to exhibit the venation of Myrtaceous leaves; and seven plates are filled with individual leaves of a considerable number of species.

In Fasc. 19 & 20, Dr. Fresenius, of Frankfort, has elaborated the Brazilian *Cordiaceæ*, *Heliotropicæ*, (which he regards as distinct orders,) and the few *Borragineæ* proper. Prof. Schuizlein contributes the *Lacistemaceæ*, of the single genus *Lacistema;* and Tulasne the *Monimiaceæ*, forming a supplement to his beautiful monograph of that order. There are two Brazilian genera, *Citriosma*, of 26 species, and *Mollinenda*, of 16.

A. G.

2. *Journal of the Proceedings of the Linnæan Society*, No. 9.—The botanical portion is filled by Prof. Lindley with the second part of his "Contributions to the Orchidology of India," and with the characters of a remarkable new Orchideous genus, *Pseudocentrum*, founded on a plant gathered in Peru by Prof. Jameson. The name is suggested by a curious caudate appendage or false spur, borne at the apex instead of the base of the labellum. Botanical papers of interest having accumulated in the hands of the Council, it is announced that supplemental botanical numbers of the Journal will be published during the current year. The first will contain an "Enumeration of the Mosses of the East Indies," by Mr. Mitten.

A. G.

3. *Lichenes Americæ Septentrionalis Exsiccati, Curante* Edvardo Tuckerman, A. M., etc. Fasc. V, and VI, Bostoniæ, Nov. Angl. 1854.—Notwithstanding the date of the title page, we believe the present volume was issued to subscribers in general only during the present year, much time having been occupied in the collection, faithful examination, and preparation of a sufficient number of these admirable specimens. This volume carries the number of species, or distinct varieties, from 101 to 150, and contains several new or rare and recently detected Lichenes, as well as characteristic and perfectly authenticated specimens of common sorts. Prof. Tuckerman's high reputation as a Lichenologist, causes these sets to be greatly sought after, at home and abroad. Here they are indispensable to the successful study of our Lichenes. All that can be needed besides, is a new edition of the synopsis of the Lichenes of the United States, from the same able hand. The fine series of forms of *Cladonia*, in these and the previous volumes, are important; and Mr. Russell's new Collemaceous genus *Leptogium* (No. 150) is worthy of particular attention.

A. G.

4. Nylander: *Synopsis Methodica Lichenum omnium hucusque cognitorum, præmissa Introductione Lingua Gallica tractata.* Fasc. I. Paris, 1858, imp. 8vo.—This is to be the standard systematic work upon Lichenes. The author, the Acharius of his day, after long investigating, with wonderful zeal and success, the Lichenes of his native Scandinavian regions, repaired to Paris and to Kew, where he has for several years studied the collections accumulated in the principal European herbaria, and he has also been furnished with materials directly from this country. This first fasciculus of the synopsis, which is to embody the result of a complete revision of the order, contains an introduction of 81 pages, in the French language, giving an account of the structure and properties of Lichenes, the principles of their classification, and their geographical distribution. The structure is illustrated by four plates. Of the systematic portion of the work, this fasciculus contains the *Collemacei* and the *Myriangeacei*. Two opuscula, issued by the same author during the past summer, are,

Enumeration Générale des Lichens, avec l'Indication sommaire de leur Distribution Geographique. (*Extr. des Mém. Soc. Imp. des Sciences Naturelles de Cherbourg.*) pp. 146. 8vo.

Expositio Synopticia Pyrenocarpeorum. (*Extr. Mem. Soc. Acad. de Maine et Loire.*) pp. 88. 8vo. A. G.

5. Miers: *Illustrations of South American Plants*, Vol. II. London, 1849, 1857. 4to.—The letter-press consists of a series of articles contributed to the Annals and Magazine of Natural History. A separate impression, in 4to form, is now issued, illustrated by 53 excellent plates. drawn by the accomplished author, and most of them lithographed by his own hand. This volume is mainly devoted to the order *Solanaceæ*, or its immediate allies; to showing the invalidity of the line which had been drawn between the *Solanaceæ* and the *Scrophulariaceæ*, and to an endeavor at clearer distinctions, through the establishment of an intermediate order, the *Atropaceæ*. The earlier sheets were issued some time previous to the appearance of the late M. Dunal's recension of the Solanaceæ in the 13th volume of De Candolle's Prodromus. The latter ones are subsequent to this publication, and contain severe criticisms upon it. The removal of the *Salpiglossideæ* from the *Scrophulariaceæ* (where Bentham had left them with much hesitation) certainly renders it more possible to limit the latter order in this direction than it was before. But the proposed order, *Atropaceæ*, probably will hardly serve its purpose. A most useful part of this volume, is the monograph of the genus *Lycium*, comprising (after considerable exclusions) 69 species, almost all of them illustrated by excellent analyses. In this department, Mr. Miers particularly excels. His whole labors, as recorded in this and the preceding volume, have thrown much light over Solanaceous plants, and will command the attention of their next monographer. A. G.

6. *Hand-book of the British Flora; a Description of the Flowering Plants and Ferns indigenous to, or naturalized in, the British Isles: for the use of Beginners and Amateurs;* by George Bentham, F.L.S. London: Lowell Reeve, 1858; pp. 655, 12mo.—One of the best of systematic botanists,—of the soundest judgment and the largest experience, both in European and exotic botany,—has deemed it no unfit employ-

ment of a portion of his valuable time to prepare a volume by which beginners, having no previous acquaintance with the science, may learn to know, most advantageously and readily, the wild flowers and plants of his native land. The result is a genuine popular Flora, and a clear proof that the plants of a limited country may be described, by one who understands them thoroughly, in comparatively simple language, without any sacrifice of scientific accuracy, or of scientific interest. No really good work of this kind was ever made by a compiler; and no one who has not essayed the task, can comprehend how thoroughly faithful writing for beginners brings one's knowledge to the proof.

The characteristic features of the work before us, are: 1, The full use of analytical keys, after the mode of De Candolle's *Flora Française*, leading easily not only to the order and the genus, but also to the species of the plant in hand. These keys, or analyses, are here made to supersede specific characters as such, neat and free descriptions, longer or shorter according to circumstances, occupying their place. But generic characters are given with considerable fullness. 2, The exclusion of all technical terms which were not required for the purpose in view, and "the omission, in numerous instances, of microscopical, anatomical, or theoretical characters, often of the greatest importance in scientific botany but useless to the mere amateur." 3, The descriptions are original, and have been drawn up from British specimens, in the first instance, and afterwards compared with the characters given in the standard Floras, and verified upon continental specimens from various parts of the geographical range of the species. As a describer of species, (which is something very different from describing *specimens*,) Mr. Bentham has no superior. 4, The geographical range of each species, at least its European range, is carefully specified: then the British stations are given, in general terms, the object being to state where the plant is likely to be found, rather than to indicate the precise spot where it has been gathered. 5, The judicious limitation of species, and the reduction of a crowd of nominal or 'critical' species to their supposed types, with a thoroughness which only a botanist of Mr. Bentham's great experience and authority could well venture upon. The following extract from the preface will explain his views:

"Taking into account the omission of all plants erroneously indicated as British, it will still, no doubt, be a matter of astonishment that, whilst the last edition of Hooker and Arnott's Flora contains 1571 species, and that of Babington's Manual as many as 1708, (exclusive of *Chara*,) that the number, in the present work, is reduced to 1285. This is not owing to any real difference of opinion as to the richness and diversity of our vegetable productions, but is occasioned by a different appreciation of the value of the species themselves. The author has long been persuaded that the views originally entertained by Linnæus, of what really constitutes a species, were far more correct than the more limited sense to which many modern botanists seem inclined to restrict the term; and that in most cases where that great master had good means of observation, he succeeded admirably in the practical application of his principles. At any rate, if those minute distinctions by which the innumerable varieties of Brambles, of Roses, of Hawk-weeds, or of Willows, have

of late years been characterized, and really more constant and more important than the author's experience has led him to conclude, they cannot be understood without a more complete acquaintance with trifling, vague, and sometimes theoretical characters, than he has himself been able to attain, or than can ever be expected from the mere amateur. * * * The species are limited according to what are conceived to have been the original principles of Linnæus: and the author, in submitting his views to the judgment of the scientific world, trusts that they will not be attributed to hasty generalizations, or conjectural theories, but that they will be generally recognized as founded on personal observation of living plants, made during many years' residence on the Continent, as well as in this country, and on repeated comparison of specimens collected from the most varied and distant points of the geographical areas of the several species."

6, Popular names are employed and reduced to a system, in accordance with the principles of botanical nomenclature. "An attempt has, on the present occasion, been made to give prominence to a series of English names to the British plants, rendering them as far as possible consistent with the recognized principles of systematic nomenclature, so essential for the study of plants. It was at first intended merely to have adopted those which are appended to all the genera and species in Hooker and Arnott's Flora; but the first attempts to apply them practically, gave evidence that they had never been framed with a view to being used by botanists, or amateurs, in place of the Latin ones. It will be observed that there is among them a continual confusion between popular, trivial, and generic names; between epithets and specific names; between substantives and adjectives; that on frequent occasions one name is applied to several genera, or several names to one genus; that the number of words forming the name of a plant varies from one to five, instead of being constantly two; and that some of the names put forward as English, are very local, almost unknown, or obsolete, and no easier to learn than the more useful Latin ones they represent. It became necessary, therefore, thoroughly to revise the whole system, and to recast it upon the Linnæan principles universally adopted for the Latin botanical names. * * * * The full statement of the principles which have induced the rejection of certain names, and the substitution of others, and the details of their application to individual cases, * * are given at length in a paper prepared by the author, to be laid before the Linnæan Society on the publication of this Flora."

Criticism may well be deferred until this paper comes to hand. Of the propriety of an English nomenclature of some kind in a Flora where a great part of the plants have well-known vernacular names, there is no room for doubt; and if used at all, it is desirable that these names should be reduced to a systematic form. This is readily done for perhaps half of the common plants of the British Flora; but for the rest, the difficulties are various and much greater than one would imagine before making the attempt. The present undertaking must be deemed a decided success. What imperfections it has, are on the safer side. We should have inclined to a larger use of the vernacular for generic names; and where they were inapplicable to whole genera, to apply them to sub-

genera, e. g.: Apple and Pear, Gooseberry and Currant. As these are real and universal English generic names, they ought, if possible, to be given as such. Still we appreciate the reasons which appear to have compelled the adoption of *Pyrus* and *Ribes* as English names, though English they never can become. Our author is strongly disposed throughout to make the Latin name do duty as an English one, doubtless supposing that they may become popular appellations in time, as *Geranium* and *Aster* have done. Sometimes he adopts the Latin word entire: sometimes he truncates or anglicises the termination. Happy instances of the latter sort, are:

Trigonel, from Trigonella.
Limosel, from Limozella.
Corydal, from Corydalis.
Corrigiole, from Corrigiola.
Chrysosplene, from Chrysosplenium; but why not *Golden-spleen?*
Samole, from Samolus; but why not *Brookweed?*
Limnanth, from Limnanthemum.
Scleranth, from Scleranthus; but why not *Knawel?*
Osmund, from Osmunda.
Myriophyll, from Myriophyllum; but why not *Milfoil?*
Matricary, for Matricaria.
Eupatory, for Eupatorium, etc.

Those names which are not at all to our taste, are:

Cerast, for Cerastium; but if such a word must be coined, why not *Holost*, for Holosteum on the preceding page?
Doronic, for Doronicum.
Onopord, for Onopordon; why not *Cotton-Thistle?*
Polycarp, (newly martyred,) for Polycarpon.
Myosote, for Myosotis; in place of *Forget-me-Not.*
Capsell, for Capsella; in place of the vernacular *Shepherd's-purse.*

The best coinage of an English name is *Rockcist* for Helianthemum.

An Introduction of 36 pages, teaches the elements of botany to beginners, and explains the technical terms used in the flora, and many besides. The definitions of *perigynous* and *epigynous*, however conformable to etymology, are not the quite usual ones, and are not adhered to in the work itself. We were not aware that "in general the word *ovary* is used to designate all the ovaries of a flower," unless when united into one body, and are glad to observe that the author does not use the word in this way in the body of the work, one or two instances excepted. We always supposed the word to be an exact synonym of the Linnæan *germen.* And if we may not use it, as botanists always have done, for the ovule-bearing portion of the pistil, whether simple or compound (reserving *carpel* for the simple or elementary pistil, whether separate or combined,) then a new word must needs be coined for this very purpose. To mistake the radicle of the embryo for the root, is common to all English botanists. The short sections upon classification and the examination and determination of plants, are full of practical wisdom. A. G.

7. *Vegetation around the Volcanic Craters of the Island of Java;* by M. H. Zollinger, (Bib. Univ., from Edinb. New Phil. Jour., April, 1858, p.

322.)—Decandolle, in his *Geographie Botanique*, has omitted to notice among vegetable stations that around volcanic craters. In Java there are more than sixty of these craters, all isolated and surrounded by vast virgin forests. When the craters are active and send forth lava, (which is not the case with the Java volcanoes,) or cinders, or sand and fragments of rock, or when they exhale continually vapors and gases, then there is no vegetation, except some Oscillarias, which are found in hot water springs. It is only when the direct volcanic action is diminished by the effect of time, or the distance of the crater, that a special vegetation appears. The craters of the Indian Archipelago are characterized by the absence of all parasitic or epiphytic plants, as well as of climbing and twining plants. Woody plants only appear at a considerable distance from the craters. We can easily distinguish three different regions: 1, an interior zone, nearest to the centre of volcanic action; 2, A middle zone surrounding the first; 3, An exterior zone.

I. *Interior Zone.*—This exhibits mostly small species scattered here and there, belonging to the lower order of plants, and to those having no corolla. Among them are, *Oscillaria labyrinthiformis*, Ag?, in warm springs; *Caladodia macilenta*, Hoff., and *C. bacillaris* or *obtusa* of Schær.; some Fungi belonging to the genus *Polyporus;* a *Marchantia;* two or three specimens of mosses; some ferns, such as *Selliguea Feei*, Bory, *Polypodium triquetrum*, Bl., *Asplenium macropyllum*, Bl., *Asplenium mucronifolium*, Bl., and *Gleichenia vulcanica*, Bl. Among Cyperaceæ, *Phacellanthus multiflorus*, Steud. *Polygonum corymbosum*, Bl., is the only Dicotyledon.

II. *Middle Region.*—Many social ferns occur here, some Dicotyledons, for the most part small shrubby plants. Among the ferns are: *Polypodium Horsefieldii*, R. Br. (3000—8000 feet), *Pteris aurita*, Bl. *Blechnum pyrophyllum*, Bl. *Gleichenia ferruginea*, Bl., *Mertensia longissima*, Kze., *Lycopodium spectabile*, Bl., *L. trichiatum*, Bory. We also meet still with *Phacellanthus multiflorus*, a Carex, *Polygonum corymbosum*, and *Imperata arundinacea.* A species of *Antennaria* and *Anaphalis* among Compositæ, and certain Ericaceæ appear; also, *Leontopodium*, *Elsholtzia elata*, *Wahlenbergia lavenduliæfolia*, DC., *Ophelia javanica.* Hassk., *O. cærulescens*, Zoll., *Melastoma setigerum*, Bl. (the cells of which are said by M. Zollinger to contain crystals of pure sulphur), *Medinilla javensis*, Bl., *Rubus lineatus*, Reinw., besides other genera and species.

III. *Exterior Region.*—This region gradually loses itself in the ordinary forest vegetation. Some rare mosses, ferns, and orchids appear at the outer portion of the region. Among other plants may be noticed *Synœcia* (Ficus) *diversifolia*, Miq., *Rhododendron javanicum*, Reinw., *Agapetes elliptica*, Don, &c. Among the common arborescent plants may be mentioned, *Agapetes varingiæfolia* Don, *A. myrtoides*, fem. *Myrsine avenis*, Bl. The beautiful *Albizzia montana*, Bth. (a social plant), *Casuarina montana*, Lesch, and *C. Junghunhniana*, Miq., are on the outer part of the region. We find also here an arborescent *Boehmeria* and a dwarf *Epilobium.* Some twining plants form transition species, such as *Nepenthes gymnamphora*, Bl., and some varieties of *Polygonum corym-*

bosum. The order Ericaceæ is the predominant one; we find, beside the species already mentioned, *Rhododendron album*, Bl. (?), *Agapetes floribunda*, Don, and other species of the genus, *Gaylussacia lanceolata*, Bl., *Parnettia repens*, Zoll., *Gaultheria punctata*, Bl. (an odoriferous plant of great beauty), *G. leucocarpa*, Bl., and others; species of *Clethra* (?). The genus Rubus is well represented. *Dodonæa viscosa*, Andr. (?), is common towards the eastern part. The orchid that approaches nearest the craters, is *Thelymitra javanica*, Bl.

These are the more common and more characteristic plants of the three crateric regions of Java, according to M. Zollinger.

8. *The Lotus or Sacred Bean of India.*—Dr. Buist gives some notes on the Lotus or Sacred Bean of India, in the Transactions of the Bombay Geographical Society. He says, "The lotus itself is one of the most elegant of eastern flowers, and seems from time immemorial to have been, in native estimation, the type of the beautiful. It is held sacred throughout the East, and the deities of the various sects in that quarter of the world are almost invariably represented as either decorated with its flowers, seated or standing on a lotus throne or pedestal, or holding a sceptre formed from its flowers, sometimes expanded and at others closed. It is fabled that the flowers obtained their red color by being dyed with the blood of Siva, when Kamadeva wounded him with the love-shaft arrow. Lakshmi is called the lotus-born from having ascended from the ocean on its flowers. The lotus is often referred to by the Hindu poets. The lotus floating on the water is the emblem of the world. It is also the type of the mountain Meru, the residence of the gods, and the emblem of female beauty.

The lotus flower is repeated, *ad infinitum*, in the earliest eastern sculptures, as that on which Bhuddah sat, and from which Bramah sprung. In the Cave Temples of Salsette, dated back several centuries before the Christian era, it is represented everywhere at once as an emblem and an ornament.

Dr. Buist thinks that Dr. Lindley is mistaken in saying that the wicks used on sacred occasions by the Hindoos, are made of the spiral vessels of the leaves of the lotus. They are formed, he says, of the dried flower-stalk or leaf-stalk; he does not believe that all the spirals of all the lotuses in India, from the Himalayas to the line, would make a lump of wick a yard long of the thickness of the finger. Individually the spirals are finer than gossamer; the leaf is fourteen by sixteen inches in diameter; the stalks about six by eight feet long, and seldom rise higher than two or two and a half feet above the surface of the water. The leaf is buoyant enough to support a crow, and is frequently made use of by that bird as a fishing station, from which flies, snails, or water lizards, are preyed upon. The flower has something of the smell of the Tonquin bean, or the blossom of the bean. The upper surface of the leaf is a deep green. It repels the water when pressed under it. This is referred to in some of the native writings, a translation of one of which is given by Dr. Buist:

> "He is not enslaved by any lust whatever;
> By the stain of passion he is not soiled,
> As in the water, yet unwet by the water,
> Is the Lotus leaf."

When the leaf is held obliquely, the light is reflected as if from a mirror. The same thing occurs with drops of water thrown upon it, and this peculiarity can only be overcome by rubbing the leaf so as to destroy the fine texture, by which the result is brought about. This seems to consist of minute capitate papillæ, by which a fine film of air is kept entangled, the water in reality never coming in contact with the actual surface of the leaf at all—a fact established and illustrated by its reflecting light from its own under surface. The same phenomenon of repulsion of water is seen in the leaves of the *Pistia stratiotes*, a floating plant abounding in shallow tanks in India. When pressed under water the leaves look like frosted silver. It is the same organization that enables roses, clover, and young cabbage leaves, young shoots of grain and grass, and the numberless other plants that exhibit dew in its beautiful pearly form, to repel water from their surface. It is the same that produces the like results usually ascribed to oil and grease on the feathers of birds, especially of water-fowls, and most of all of divers—which when they plunge under the surface seem to carry with them a perfect flash of light. A piece of glass, a varnished or greased surface, or polished stone, throws the water off as perfectly as the various matters enumerated, but in none of these latter cases is there any appearance of reflection.

Dr. Buist, on examining the lotus leaf in a little pool of water, noticed thin films of air arising leisurely and adhering to the leaf. The water flowing over them, by the reflecting light from its under surface, shows the area over which the air was emanating. The air gradually collected into bubbles and then rose to the surface. The quantity of air which rises is very great—especially from the spiral vessels when wounded in any way. A single stem of one-third of an inch in diameter, containing tubes of a sectional area of not more than one-quarter of this, or say two-tenths of an inch square, even where the leaf is cut off, has been ascertained by experiment to discharge thirty-three cubic inches of air hourly. The velocity with which the column advances must be at the rate of twenty feet an hour.—*Ed. N. Phil. J.*, [2], vii, 323.

9. *Hairs of Urticaceæ.*—The stinging hairs (*stimuli*) of Urticaceæ consist of a single cell, more or less elongated, swollen at its base, where it is sheathed by a layer of epidermal cells, and terminated sometimes by a sharp point, but more commonly by a small rounded pyriform or acuminated knob. This hair becomes broken in the skin, and allows the acrid fluid it contains to flow out. This gives rise to accidents of a more or less severe nature. The severity of the sting depends not on the quantity of fluid which enters the puncture, but rather on its activity. The sheathing or bulbous portion of the hairs varies much in length. Sometimes it exceeds the free portion, as in *Urtica ferox*, one of the species, which gives a most dangerous sting. In some species of Urera and in one or two other genera, the sheathing portion increases much with age, becomes woody, and forms a true prickle or aculeus, analogous to those of the Rose and of some species of Hibiscus.

Glandular hairs, properly so called, are rare among the Urticaceæ. Species of *Fleury* present examples of these hairs, as well as the ribs of the lower surface of *Parietaria communis*, on which we also notice, as in *Forskohlea* and some other genera, hooked or uncinate hairs. The spe-

cies of *Forskohlea* or of *Droguetia* exhibit in different parts of their inflorescence a mass of woolly hairs analagous to those which cover the cotton plant. None of the Urticaceæ have webbed hairs.—*Ibid*, p, 324.

10. *The Complete Writings of Thomas Say on the Conchology of the United States;* edited by W. G. BINNEY, member of the Academy of Natural Sciences, of Philadelphia, etc. pp. 252, 8vo, with 75 plates. New York: H. Bailliere, 1858.—The republication of the works of our earlier scientific writers, if not constituting an actual advance in science, is certainly as generally useful, and in many cases even more so, than the announcement of new observations. The reprint before us of the results of the conchological labors of the father of American zoology, supplies what has long been needed by those interested in this department, and reflects equal credit upon the editor who has collected them, and the house who have undertaken their publication. The articles now first brought together into one volume, are found chiefly in scientific books and periodicals now out of print or very difficult of access; and the obstacles in the way of reference to them, have deterred or discouraged many a young naturalist from the study of our shells. This remark applies more particularly to our fresh water univalves, and the marine shells of the southern coast; the works of Gould, Binney, and Lea, having done much to elucidate the other divisions. With the volume before us, however, complete as it is both in text and plates, the study of our testaceous mollusks becomes comparatively easy. A little additional bibliographical research, will give the student all that is known on the subject, as the works of the other authors may for the most part be easily obtained.

The descriptions of terrestrial shells are collected together in the first forty pages, but all the others are arranged in the order of their respective dates. So that the genera and families are not grouped together, and sometimes there are remarks on the same species in various parts of the book. But for the convenience of those who would study the species of each genus together, or read at once all that relates to a single species, a full and elaborate index is appended, "to all the generic and specific descriptions of shells of Thomas Say, and to the synonyms used in his writings, with the name, date, volume, page, and figure of the original works containing them." This index would alone be of great use, being the first ever drawn up of Say's writings upon conchology. No attempt is made to complete the synonymy of Say's species, from European works, which now becomes highly desirable.

The plates, seventy-five in number, are mostly printed from the original coppers used by Say. Some of these are remarkable for an accuracy and beauty which is somewhat surprising, when we consider the time and place of their production, (New Harmony, Indiana, 1830). Plate 15, and those from Nicholson's Encyclopedia, (Pl. 69–72,) are fac-similes of the originals. Pl. 75, although prepared by Mr. Say, is now for the first time published. The size of the work is convenient, the text compact, and the printing good, although the typographical errors seem unfortunately numerous.

Extracts from the Address of Prof. Owen, *President of the British Association, at Leeds, Sept.* 22, 1858.—*Athen.*, No, 1613, 394.

We are here met, in this our twenty-eighth annual assembly, having accepted for the present year, the invitation of the flourishing town and firm seat of British manufacturing energy, Leeds, to continue the aim of the Association, which is the promotion of Science or knowledge of the laws of Nature; whereby we acquire a dominion over nature, and are thereby able so to apply her powers as to advance the well-being of society and exalt the condition of mankind. It is no light matter, therefore, the work we are here assembled to do. God has given to man a capacity to discover and comprehend the laws by which His universe is governed; and man is impelled by a healthy and natural impulse to exercise the faculties by which that knowledge can be acquired. Agreeably with the relations which have been instituted between our finite faculties and the phenomena that affect them, we arrive at demonstrations and convictions which are the most certain that our present state of being can have or act upon. Nor let any one, against whose prepossession a scientific truth may jar, confound such demonstrations with the speculative philosophies condemned by the Apostle; or ascribe to arrogant intellect, soaring to religions of forbidden mysteries, the acquisition of such truths as have been or may be established by patient and inductive research. For the most part, the discoverer has been so placed by circumstances,—rather than by predeterminated selection,—as to have his work of investigation allotted to him as his daily duty; in the fulfillment of which he is brought face to face with phenomena into which he must inquire, and the result of which inquiry he must faithfully impart. The advance of natural as of moral truth, has been and is progressive: but it has pleased the Author of all truth to vary the fashion of the imparting of such parcels thereof as He has allotted, from time to time, for the behoof and guidance of mankind. Those who are privileged with the faculties of discovery are, therefore, to be regarded as preördained instruments in making known the power of God, without a knowledge of which, as well as of Scripture, we are told that we shall err. Great and marvellous have been the manifestations of this power imparted to us of late times, not only in respect of the shape, motions and solar relations of the earth, but also of its age and inhabitants.

Geological Time.—In regard to the period during which the globe allotted to man has revolved in its orbit, present evidence strains the mind to grasp such sum of past time with an effort like that by which it tries to realize the space dividing that orbit from the fixed stars and remoter nebulæ. Yet, during all those eras that have passed since the Cambrian rocks were deposited which bear the impressed record of creative power, as it was then manifested, we know, through the interpreters of these "writings on stone," that the earth was vivified by the sun's light and heat, was fertilized by refreshing showers and washed by tidal waves. No stagnation has been permitted to air or ocean. The vast body of waters not only moved, as a whole, in orderly oscillations, regulated, as now, by sun and moon, but were rippled and agitated here and

there successively by wind and storms. The atmosphere was healthily influenced by its horizontal currents, and by ever-varying clouds and vapors rising, condensing, dissolving, and falling in endless vertical circulation. With these conditions of life, we know that life itself has been enjoyed throughout the same countless thousands of years; and that with life, from the beginning, there has been death. The earliest testimony of the living thing, whether shell, crust, or coral in the oldest fossiliferous rock, is at the same time proof that it died. It has further been given us to know, that not only the individual but the species perishes; that as death is balanced by generation, so extinction has been concomitant with creative power, which has continued to provide a succession of species; and furthermore, that as regards the varying forms of life which this planet has witnessed, there has been "an advance and progress in the main." Geology demonstrates that the creative force has not deserted this earth during any of her epochs of time; and that in respect to no one class of animals has the manifestation of that force been limited to one epoch. Not a species of fish that now lives, but has come into being during a comparatively recent period; the existing species were preceded by other species, and these again by others still more different from the present. No existing genus of fishes can be traced back beyond a moiety of known creative time. Two entire orders (Cycloids and Ctenoids) have come into being, and have almost superseded two other orders (Ganoids and Placoids), since the newest or latest of the secondary formations of the earth's crust. Species after species of land animals, order after order of air-breathing reptiles, have succeeded each other; creation ever compensating for extinction. The successive passing away of air-breathing species may have been as little due to exceptional violence and as much to natural law, as in the case of marine plants and animals. It is true, indeed, that every part of the earth's surface has been submerged; but successively, and for long periods. Of the present dry land different natural continents have different Faunæ and Floræ; and the fossil remains of the plants and animals of these continents respectively show that they possessed the same peculiar characters, or characteristic *facies*, during periods extending far beyond the utmost limits of human history. Such, gentlemen, is a brief summary of facts most nearly interesting us, which have been demonstratively made known respecting our earth and its inhabitants. And when we reflect at how late and in how brief a period of historical time the acquisition of such knowledge has been permitted, we must feel that vast as it seems, it may be but a very small part of the patrimony of truth destined for the possession of future generations. * * *

Earth's Magnetism.—Magnetism has been studied with two aims: the one, to note the numerical relations of its activity to time and space, both in respect of its direction and intensity; the other, to penetrate the mystery of the nature of the magnetic force. In reference to the first aim, my estimable predecessor adverted, last year, to the fact, that it was in the committee-rooms of the British Association that the first step was taken towards that great magnetic organization which has since borne so much fruit. Thereby it has been determined that there are periodical changes of the magnetic elements depending on the hour of the day, the season of the year, and on what seemed strange intervals of about eleven

years. Also, that besides these regular changes, there were others of a more abrupt and seemingly irregular character—Humboldt's "magnetic storms"—which occur simultaneously at distant parts of the earth's surface. Major-General Sabine, than whom no individual has done more in this field of research since Halley first attempted "to explain the change in the variation of the magnetic needle," has proved that the magnetic storms observed diurnal, annual, and undecennial periods. But with what phase or phenomenon of earthly or heavenly bodies, it may be asked, has the magnetic period of eleven years to do? The coincidence which points to, if it does not give, the answer, is one of the most remarkable, unexpected, and encouraging to patient observers. For thirty years a German astronomer, Schwabe, had set himself the task of daily observing and recording the appearance of the sun's disc, in which time he found the spots passed through periodic phases of increase and decrease, the length of the period being about eleven years. A comparison of the independent evidence of the astronomer and magnetic observer, has shown that the undecennial magnetic period coincides both in its duration and in its epochs of maximum and minimum with the same period observed in the solar spots. * * *

Electric Currents in Animals.—Galvani arranged the parts of a recently-mutilated frog so as to bring a nerve in contact with the external surface of a muscle, when a contraction of the muscle ensued. In this suggestive experiment the Italian philosopher, who thereby initiated the inductive inquiry into the relation of the nerve force to electric force, concluded that the contraction was a necessary consequence of the passage of electricity from one surface to the other by means of the nerve. He supposed that the electricity was secreted by the brain, and transmitted by the nerves to different parts of the body, the muscles serving as reservoirs of the electricity. Volta made a further step by showing that under the conditions or arrangements of Galvani's experiments, the muscle would contract, whether the electric current had its origin in the animal body, or from a source external to that body. Galvani erred in too exclusive a reference of the electric force producing the contraction to the brain of the animal: Volta in excluding the origin of the electric force from the animal body altogether. The determination of "the true" and "the constant," in these recondite phenomena, has been mainly helped on by the persevering and ingenious experimental researches of Mateucci and Du Bois Reymond. The latter has shown that any point of the surface of a muscle is positive in relation to any point of the divided or transverse section of the same muscle; and that any point of the surface of a nerve is positive in relation to any point of the divided or transverse section of the same nerve. Mr. Baxter, in still more recent researches, has deduced important conclusions on the origin of the muscular and nerve currents, as being due to the polarized condition of the nerve or muscular fibre, and the relation of that condition to changes which occur during nutrition. From the present state of neuro-electricity, it may be concluded that nerve force is not identical with electric force, but that it may be another mode of motion of the same common force; it is certainly a polar force, and perhaps the highest form of a polar force. * * *

Photography—Electric Telegraph.—Since Niepce, Herschel, Fox Talbot, and Daguerre laid the foundation of Photography, year by year some improvement is made,—some advance achieved, in this most subtle application of combined discoveries in Photicity, Electricity, Chemistry, and Magnetism. Last year Mr. Poitevin's production of plates in relief, for the purpose of engraving by the action of light alone, was cited as the latest marvel of Photography. This year has witnessed photographic printing in carbon by Mr. Pretschi.—Prof. Owen continued by alluding to the application of photography for obtaining views of the moon, of the planets, of scientific and other phenomena. After referring to the discoveries in Electro-magnetism, the lecturer continued—Remote as such profound conceptions and subtle trains of thought seem to be from the needs of every-day life, the most astounding of the practical augmentation of man's power has sprung out of them. Nothing might seem less promising of profit than Oersted's painfully-pursued experiments, with his little magnets, voltaic pile, and bits of copper wire. Yet out of these has sprung the electric telegraph. Oersted himself saw such an application of his convertibility of electricity into magnetism, and made arrangements for testing that application to the instantaneous communication of signs through a distance of a few miles. The resources of inventive genius have made it practicable for all distances; as we have lately seen in the submergence and working of the electro-magnetic cord connecting the Old and the New World. On the 6th of August, 1858, the laying down of upwards of 2,000 nautical miles of the telegraphic cord, connecting Newfoundland and Ireland, was successfully completed; and on that day a message of thirty-one words was transmitted in thirty-five minutes, along the sinuosities of the submerged hills and valleys forming the bed of the great Atlantic. The first message expressed—"Glory to God in the highest: on Earth Peace, Good-will towards Men." Never since the foundations of the world were laid could it be more truly said, "The depths of the sea praise Him!" More remains to be done before the far-stretching engine can be got into full working order; but the capital fact, viz: the practibility of bringing America into electrical communication with Europe has been demonstrated; consequently, a like power of instantaneous interchange of thought between the civilized inhabitants of every part of the globe, becomes only a question of time. The powers and benefits thence to ensue for the human race can be but dimly and inadequately foreseen. * * *

Homology.—After pointing out the distinction between Affinity, which indicates an intimate resemblance, and Analogy, which indicates a remoter one, Prof. Owen continued—The study of homologous parts of a single system of organs—the bones—has mainly led to the recognition of the plan of archetype of the highest primary group of animals, the Vertebrata. The next step of importance will be to determine the homologous parts of the nervous system, of the muscular system, of the respiratory and vascular system, and of the digestive, secretory and generative organs in the same primary group or province. I think it of more importance to settle the homologies of the parts of a group of animals constructed on the same general plan, than to speculate on such relations of parts of animals constructed on demonstratively distinct plans of or-

ganization. What has been effected and recommended, in regard to homologous parts in the Vertebrata, should be followed out in the Articulata and Mollusca. In regard to the constituents of the crust or outer skeleton and its appendages in the Articulata, homological relations have been studied and determined to a praiseworthy extent, throughout that province. The same study is making progress in the Mollusca; but the grounds for determining special homologies are less sure in this subkingdom. The present state of homology in regard to the Articulata, has sufficed to demonstrate that the segment of the crust is not a hollow expanded homologue of the segment of the endo-skeleton of a vertebrate. There is as little homology between the parts and appendages of the segments of the Vertebrate and Articulate skeletons respectively. The parts called mandibles, maxillæ, arms, legs, wings, fins, in Insects and Crustaceans, are only "analogous" to the parts so called in Vertebrates. A most extensive field of reform is becoming open to the homologist in that which is essential to the exactitude of his science—a nomenclature equivalent to express his conviction of the different relations of similitude. Most difficult and recondite are the questions in face of which the march of Homology is now irresistibly conducting the philosophic observer. Such, for instance, as the following: Are the nervous, muscular, digestive, circulating and generative systems of organs more than functionally similar in any two primary provinces of the animal kingdom? Are the homologies of entire systems to be judged of by their functional and structural connexions, rather than by the plan and course of their formation in the embryo? It may be doubted if embryology alone is decisive of the question whether homology can be predicated of the alimentary canal in animals of different primary groups or provinces. It is significant, however, of the lower value of embryological characters, to note that the great leading divisions of the animal kingdom, based by Cuiver on Comparative Anatomy, have merely been confirmed by von Baer's later developmental researches. * * *

Parthenogenesis.—John Hunter first enunciated the general proposition that "the propagation of plants depended on two principles, the one that every part of a vegetable is 'a whole,' so that it is capable of being multiplied as far as it can be divided into distinct parts; the other, that certain of those parts become reproductive organs, and produce fertile seeds." Hunter also remarked, that "the first principle operated in many animals which propagate their species by buds or cuttings;" but that, whilst in animals, it prevailed only in "the more imperfect orders," it operated in vegetables "of every degree of perfection." The experiments of Trembley on the fresh water polyp, those of Spalanzani on the Naids, and those of Bonnet on the Aphides, had brought to light the phenomena of propagation by fission, and by gemmation or buds, external and internal, in animals, to which Hunter refers. Subsequent research has shown the unexpected extent to which Hunter's first principle of propagation in organic being prevails in the animal division. But the earliest formal supercession of Harvey's axiom, "*omne vivum ab ovo*," appears to be Hunter's proposition of the dual principle above quoted. The experiments of Redi, Malpighi and others had progressively contracted the field to which the "*generatio æquivoca*" could with any plausibility be

applied. The stronghold of the remaining advocates of that old Egyptian doctrine was the fact of the development of parasitic animals in the flesh, brain and glands of higher animals. But the hypothesis never obtained currency in this country; it was publicly opposed in my 'Hunterian Lectures,' by the fact of the prodigious preparation of fertile eggs in many of the supposed spontaneously developed species; and in then suggesting that the *Trichina spiralis* of the human muscular tissue might be the embryo of a larger worm in course of migration, I urged that a particular investigation was needed for each particular species.

Among the most brilliant of recent acquisitions to this part of Physiology, have been the discoveries which have resulted from such special investigations. Kuchenmeister and von Siebold have been the chief laborers in this field. After noticing some of the results of those labors, Prof. Owen said,—Since the time when it was first discovered that plants and animals could propagate in two ways, and that the individual developed from the bud might produce a seed or egg, from which also an individual might spring capable of again budding,—since this alternating mode of generation was observed, as by Chamisso and Sars, in cases where the budding individual differed much in form from the egg-laying one—the subject has been systematized and generalized, with an attempt to explain its principle and greatly advance, especially and in a highly interesting manner, in von Siebold's late treatise, entitled 'Wahre Parthenogenesis bei Schmeterlingen und Bienen,' in which the virgin production of the male or drone-bee is demonstrated. Von Siebold, having subjected to the closest microscopic scrutiny and experiment the conclusion to which the practical Bee-master Dzierzon had arrived, relative to the cause of queen-bees with crippled wings producing a swarm exclusively of drones, has demonstrated that the male bee is produced from an egg which has been subjected to no influence save that of the maternal parent; whilst such egg, if impregnated, would have produced a female or working bee. The now well-investigated phenomena of parthenogenesis in Hydrozoa have resulted in showing, as in the analogous case of Entozoa, that animals differing so much in form as to have constituted two distinct orders or classes, are really but two terms of a cycle of metagenetic transformations—the acalephan Medusa being the sexual locomotive form of the agamic rooted budding polyp, just as the cestoid tænia is of the cystic hydatid. In Hydrozoa (hydroid polyps or sertularians) the young are propagated, as in plants, by "buds," and also, as in most plants, by "germs" or "seeds:" these latter are contained in "germ-sacs" projecting from the outer surface, which is another analogy to the flowering parts of plants. The first acquaintance with these marvels excited the hope that we were about to penetrate the mystery of the origin of different species of animals; but as far as observation has yet extended, the cycle of changes is definitely closed. And, since one essential step in the series is the fertilized seed or egg, the Harveian axiom, "*omne vivum ab ovo*," if metagenetic phases be ascribed to one individual, may be still predicated of all organisms which bear the unmistakable characters of plants or of animals. The closest observations of the subjects of these two kingdoms most favorable to clear insight into the nature of their beginning, accumulate evidence in proof of the essen-

tial first step being due to the protoplasmic matter of a germ-cell and sperm-cell; the former pre-existing in the form of a nucleus or protoplast, the latter as a granulose fluid. In flowering plants it is conveyed by the pollen-tube, in animals and many flowerless plants, by locomotive spermatozoids. The changes of form which the representative of a species undergoes in successive agamically propagating individuals are termed the "metagenesis" of such species. The changes of form which the representative of a species undergoes in a single individual, is called the "metamorphosis." But this term has practically been restricted to the instances in which the individual, during certain phases of the change, is free and active, as in the grub of the chaffer, or the tadpole of the frog, for example. In reference to some supposed essential differences in the metamorphoses of insects, it had been suggested that stages answering to those represented by the apodal and acephalous maggot of the Diptera, by the hexapod larva of the Carabi, and by the hexapod anteniferous larva of the Meloe, were really passed through by the orthopterous insect, before it quitted the egg. Mr. Andrew Murray has recently made known some facts in confirmation of this view. He had received a wooden idol from Africa, behind the ears of which a Blatta had fixed its egg-cases, after which the whole figure had been rudely painted by the natives, and these egg-cases were covered by the paint. No insect could have emerged without breaking through the case and the paint; but both were uninjured. In the egg-cases were discovered, 1st, a grub-like larva in the egg; 2d, a cocoon in the egg containing the unwinged, imperfectly developed insect; 3d, the unwinged, imperfectly developed insect in the egg, free from the cocoon, and ready to emerge. * * *

Geographical and Geological Distribution of Species.—Observations of the characters of plants have led to the recognition of the natural groups or families of the vegetable kingdom, and to a clear scientific comprehension of that great kingdom of nature. This phase of botanical science gives the power of further and more profitable generalizations, such as those teaching the relations between the particular plants and particular localities. The sum of these relations, forming the geographical distributions of plants, rests, perhaps at present necessarily, on an assumption, viz: that each species has been created, or come into being, but once in time and space; and that its present diffusion is the result of its own law of reproduction, under the diffusive or restrictive influence of external circumstances. These circumstances are chiefly temperature and moisture, dependent on the distance from the source of heat and the obliquity of the sun's rays, modified by altitude above the sea-level, or the degree of rarefaction of the atmosphere and of the power of the surface to wastefully radiate heat. Both latitude and altitude are further modified by currents of air and ocean, which influence the distribution of the heat they have absorbed. Thus large tracts of dry land produce dry and extreme climates, while large expanses of sea produce humid and equable climates. Agriculture affects the geographical distribution of plants, both directly and indirectly. It diffuses plants over a wider area of equal climate, augments their productiveness, and enlarges the limits of their capacity to support different climatal conditions. Agriculture also effects local modifications of climate. Certain species of plants re-

quire more special physical conditions for health; others more general conditions; and their extent of diffusion varies accordingly. Thus the plants of temperate climates are more widely diffused over the surface of the globe, because they are suited to elevated tracts in tropical latitudes. There is, however, another law which relates to the original appearance, or creation, of plants, and which has produced different species flourishing under similar physical conditions, in different regions of the globe. Thus the plants of the mountains of South America are of distinct species, and for the most part of distinct genera, from those of Asia. The plants of the temperate latitudes of North America are of distinct species, and some of distinct genera from those of Europe. The Cacteæ of the hot regions of Mexico are represented by the Euphorbiaceæ in parts of Africa having a similar climate. The surface of the earth has been divided into twenty-five regions, of which I may cite as examples that of New Zealand, in which Ferns predominate, together with generic forms, half of which are European, and the rest approximating to Australian, South African, and Antarctic forms; and that of Australia, characterized by its Eucalypti and Epacrides, chiefly known to us by the researches of the great botanist, Robert Brown, the founder of the Geography of Plants.

Organic Life in its animal form is much more developed and more variously in the sea, than in its vegetable form. Observations of marine animals and their localities have led to attempts at generalizing the results; and the modes of enunciating these generalizations or laws of geographical distribution are very analogous to those which have been applied to the vegetable kingdom, which is as diversely developed on land as the animal kingdom in the sea. The most interesting form of expression of the distribution of marine life, is that which parallels the perpen ticular distribution of plants. Edward Forbes has expressed this by defining five bathymetrical zones, or belts of depth, which he calls,—1, Littoral; 2, Circumlittoral; 3, Median; 4, Infra-median; 5, Abyssal. The life-forms of these zones vary, of course, according to the nature of the sea-bottom; and are modified by those primitive or creative laws that have caused representative species in distant localities under like physical conditions,—species related by analogy. Very much remains to be observed and studied by naturalists in different parts of the globe, under the guidance of the generalizations thus sketched out, to the completion of a perfect theory. But in the progress to this, the results cannot fail to be practically most valuable. A shell or a sea-weed, whose relations to depth are thus understood, may afford important information or warning to the navigator. To the geologist, the distribution of marine life according to the zones of depth, has given the clue to the determination of the depth of the seas in which certain formations have been deposited. Had all the terrestrial animals that now exist diverged from one common centre within the limited period of a few thousand years, it might have been expected that the remoteness of their actual localities from such ideal centre would bear a certain ratio with their respective powers of locomotion. With regard to the class of Birds, one might have expected to find that those which were deprived of the power of flight, and were adapted to subsist on the vegetation of a warm or temperate latitude, would still be met with more or less

associated together, and least distant from the original centre of dispersion, situated in such a latitude. This, however, is not only not the case with birds, but is not so with any other class of animals. The Quadrumana, or order of apes, monkeys and lemur, consist of three chief divisions—Catharines, Platyrhines, and Strepsirhines. The first family is peculiar to the "Old World;" the second to South America; the third has the majority of its species and its chief genus, (Lemur,) exclusively in Madagascar. Out of twenty-six known species of Lemuridæ, only six are Asiatic, and three are African. Whilst adverting to the geographical distribution of Quadrumana, I would contrast the peculiarly limited range of the orangs and chimpanzees with the cosmopolitan powers of mankind. The two species of orang (Pithecus) are confined to Borneo and Sumatra; the two species of chimpanzee (Troglodytes) are limited to an intertropical tract of the western part of Africa. They appear to be inexorably bound by climatal influences regulating the assemblage of certain trees and the production of certain fruits. Climate rigidly limits the range of the Quadrumana latitudinally; creational and geographical causes limit their range in longitude. Distinct genera represent each other in the same latitudes of the New and Old Worlds; and also, in a great degree, in Africa and Asia. But the development of an orang out of a chimpanzee, or reciprocally, is physiologically inconceivable.

The order of Ruminantia is principally represented by Old World species, of which 162 have been defined; whilst only 24 species have been discovered in the New World, and none in Australia, New Guinea, New Zealand, or the Polynesian Isles. The camelopard is now peculiar to Africa; the musk-deer to Africa and Asia; out of about fifty defined species of antelope, only one is known in America, and none in the central and southern divisions of the New World. Palæontology has expanded our knowledge of the range of the giraffe; during Miocene or old Pliocene periods, species of Camelopardalis roamed in Asia and Europe. Geology gives a higher range to the horse and elephant kinds than was cognizant to the student of living species only. The existing Equidæ and Elephantidæ properly belong, or are limited to, the Old World; and the elephants to Asia and Africa, the species of the two continents, being quite distinct. The horse, as Buffon remarked, carried terror to the eye of the indigenous Americans, viewing the animal for the first time, as it proudly bore their Spanish conquerer. But a species of Equus, coëxisted with the Megatherium and Megalonyx, in both South and North America, and perished apparently with them before the human period. Elephants are dependent chiefly upon trees for food. One species now finds conditions of existence in the rich forests of tropical Asia; and a second species in those of tropical Africa. Why, we may ask, should not a third be living at the expense of the still more luxuriant vegetation watered by the Orinoco, the Essequibo, the Amazon, and the La Plata, in tropical America? Geology tells us that at least two kinds of elephant (*Mastodon Andium* and *M. Humboldtii*) formerly did derive their subsistence, along with the great Megatherioid beasts, from that abundant source. We may infer that the general growth of large forests, and the absence of deadly enemies, were the main conditions of the former existence of elephantine animals over every part of the globe.

We have the most pregnant proof of the importance of Palæontology in rectifying and expanding ideas deduced from recent zoology of the geographical limits of particular forms of animals, by the results of its application to the proboscidian or elephantine family.

But such retrospective views of life in remote periods, in many important instances, confirm the zoologist's deductions of the originally restricted range of particular forms of mammalian life. The sum of all the evidence from the fossil world in Australia, proves its mammalian population to have been essentially the same in pleistocene times, as now, —only represented, as the Edentate mammals in South America were then represented, by more numerous genera, and much more gigantic species, than now exist.

But Geology has revealed more important and unexpected facts relative to the marsupial type of quadrupeds. In the miocene and eocene tertiary deposits, marsupial fossils of the American genus Didelphys have been found, both in France and England; and they are associated with Tapirs like that of America. In a more ancient geological period remains of marsupials, some insectivorous, as Spalacotherium and Triconodon, others with teeth like the peculiar premolars in the Australian genus Hypsipromnus, have been found in the upper oolite of the Isle of Purbeck. In the lower oolite at Stonesfield, Oxfordshire, marsupial remains have been found having their nearest living representatives in the Australian genera Myrmecobius and Dasyurus. Thus it would seem, that the deeper we penetrate the earth, or, in other words, the further we recede in time, the more completely we are absolved from the present laws of geographical distribution. In comparing the mammalian fossils found in British pleistocene and pliocene beds, we have often to travel to Asia or Africa for their homologues. In the miocene and eocene strata some fossils occur which compel us to go to America for the nearest representatives. To match the mammalian remains from the English oolitic formations, we must bring species from the Antipodes. These are truly most suggestive facts. If the present laws of geographical distribution depend, in an important degree, upon the present configuration and position of continents and islands, what a total change in the geographical character of the earth's surface must have taken place since the "Stonesfield slate" was deposited in what now forms the county of Oxfordshire! These and the like considerations from the modifications of geographical distribution of particular forms or groups of animals, warn us how inadequate must be the phenomena connected with the present distribution of land and sea to guide to the determination of the primary ontological divisions of the earth's surface. Some of the latest contributions to this most interesting branch of natural history have been the result of endeavors to determine whether, and how many, distinct creations of plants and animals have taken place. But, I would submit that the discovery of two portions of the globe, of which the respective Faunæ and Floræ are different, by no means affords the requisite basis for concluding as to distinct acts of creation. Such conclusion is associated, perhaps unconsciously, with the idea of the historical date of creative acts: it pre-supposes that the portion of the globe so investigated by the botanist and zoologist has been a separate and primitive creation,—

that its geographical limits and features are still in the main what they were when the creative fiat went forth. But geology has demonstrated that such is by no means the case with respect to the portions of dry land now termed continents and islands. The incalculable vistas of time past into which the same science has thrown light, are also shown to have periods during which the relative positions of land and sea have been ever changing.

Already the directions, and to a certain extent the forms of the submerged tracts that once joined what now are islands to continents, and which once united now separate or nearly disjoined continents by broad tracts of continuity, begin to be laid down in geological maps, addressing to the eye such successive and gradually progressive alterations of the earth's surface. These phenomena shake our confidence in the conclusion, that the Apteryx of New Zealand and the Red-grouse of England were distinct creations in and for those islands respectively. Always, also, it may be well to bear in mind that by the word "creation" the zoologist means "a process he knows not what." Science has not yet ascertained the secondary causes that operated when "the earth brought forth grass, and herb yielding seed after his kind," and when "the waters brought forth abundantly the moving creatures that hath life." And supposing both the fact and the whole process of the so-called "spontaneous generation" of a fruit-bearing tree, or of a fish, were scientifically demonstrated, we should still retain as strongly the idea, which is the chief of the "mode" or "group of ideas" we call "creation," viz: that the process was ordained by, and had originated from, an all-wise and powerful First Cause of all things. When, therefore, the present peculiar relation of the Red-grouse (*Tetrao scoticus*) to Britain and Ireland—and I cite it as one of a large class of instances in Geographical Zoology—is enumerated by the zoologist as evidence of a distinct creation of the bird in and for such islands, he chiefly expresses that he knows not how the Red-grouse came to be there and there exclusively; signifying also by this mode of expressing such ignorance, his belief that both the bird and the islands owed their origin to a great first Creative Cause. And this analysis of the real meaning of the phrase "distinct creation," has led me to suggest whether, in aiming to define the primary zoological provinces of the globe, we may not be trenching upon a province of knowledge beyond our present capacities; at least in the judgment of Lord Bacon, commenting upon man's efforts to pierce into the "dead beginnings of things."

Extinction of Species.—On the few occasions in which I have been led to offer observations on the probable cause of the extinction of species, the chief weight has been given to those gradual changes in the conditions of a country affecting the due supply of sustenance to animals in a state of nature. I have also pointed out the characters in the animals themselves calculated to render them most obnoxious to such extirpating influences; and on one occasion I have applied the remarks to the explanation of so many of the larger species of particular groups of animals having become extinct, whilst smaller species of equal antiquity have remained. In proportion to its bulk is the difficulty of the contest which, as a living organized whole, the individual of such species

has to maintain against the surrounding agencies that are ever tending to dissolve the vital bond and subjugate the living matter to the ordinary chemical and physical forces. Any changes, therefore, in such external agencies as a species may have been originally adapted to exist in, will militate against that existence in a degree proportionate, perhaps in a geometrical ratio, to the bulk of the species. If a dry season be gradually prolonged, the large mammal will suffer from the drought sooner than the small one: if such alteration of climate affect the quantity of vegetable food, the bulky herbivore will first feel the effects of stinted nourishment; if new enemies are introduced, the large and conspicuous quadruped or bird will fall a prey, while the smaller species conceal themselves and escape. Smaller animals are usually also more prolific than larger ones. "The actual presence, therefore, of small species of animals in countries where larger species of the same natural families formerly existed, is not the consequence of any gradual diminution of the size of such species, but is the result of circumstances which may be illustrated by the fable of the 'Oak and the Reed;' the smaller and feebler animals have bent and accommodated themselves to changes which have destroyed the larger species." No doubt the type-form of any species is that which is best adapted to the conditions under which such species at the time exists; and as long as those conditions remain unchanged, so long will the type remain; all varieties departing therefrom being in the same ratio less adapted to the environing conditions of existence. But, if those conditions change, then the variety of the species at an antecedent date and state of things will become the type-form of the species at a later date, and in an altered state of things. Observation of animals in a state of nature is required to show their degree of plasticity, or the extent to which varieties do arise: whereby grounds may be had for judging of the probability of the elastic ligaments and joint-structures of a feline foot, for example, being superinduced upon the more simple structure of the toe with the non-retractile claw, according to the principle of a succession of varieties in time. Observation of fossil remains is also still needed to make known the ante-types, in which varieties, analogous to the observed ones in existing species, might have occurred, so as to give rise ultimately to such extreme forms as the Giraffe, for example.

Man.—The aboriginal laws of the geographical distribution of plants and animals, have been modified from of old by geological and the concomitant climatal changes; and much more by man since his introduction upon the globe. The serviceable plants and animals which he has carried with him in his migrations have flourished and multiplied in lands the most remote from the habitats of the aboriginal species. Man has, also, been the most potent and intelligible cause of the extirpation of species within historic times. He alone, with one of the beasts which he has domesticated—the dog—is cosmopolitan. The human species is represented by a few well-marked varieties; and there is a certain amount of correspondence between their localities and general zoological provinces. But with regard to the alleged conformity between the geographical distribution of man and animals, which has of late been systematically enunciated, and made by Agassiz, in Gliddon and Nott's 'Va-

rieties of Mankind,' the basis of deduction as to the origin and distinction of the human varieties, many facts might be cited, affecting the conformity of the distribution of man with that of the lower animals and plants, as absolutely enunciated in some recent works. Nor can we be surprised to find that the migratory instincts of the human species, with the peculiar endowment of adaptiveness to all climates, should have produced modifications in geographical distribution to which the lower forms of living nature have not been subject. Ethnology is a wide and fertile subject, and I should be led far beyond the limits of an inaugural discourse were I to indulge in an historical sketch of its progress.

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IV. ASTRONOMY.

1. *Fifty-fourth and fifty-fifth Asteroids.*—On the 10th of September, 1858, another asteroid was discovered by Mr. H Goldschmidt at Paris, and the same night a new asteroid was also detected by Mr. George Searle, assistant at the Dudley Observatory, Albany, N. Y. It remains to be seen which of these two asteroids was first discovered in absolute time.

2. *Fourth Comet of* 1858.—A telescopic comet was discovered, May 21st, 1858, by Dr. Bruhns, at Berlin. It appeared in the comet-seeker like a star of the 7th magnitude, with a tail about half a degree in length.

3. *Fifth Comet of* 1858.—The great comet of 1858 was discovered at Florence, on the 2d of June, by Mr. Donati. Owing to its great distance from the earth and the slowness of its geocentric motion, for some time computors were greatly perplexed in determining correct elements of its path. It soon, however, became apparent that it was a comet of remarkable magnitude, and in accordance with prediction, on the 19th of July it surpassed the average of telescopic comets.

The first traces of a tail were not noticed until the 20th of August—on the 29th it was visible to the naked eye, and a train of two degrees in length could be traced with the comet-seeker. For a short time it was visible to us, both morning and evening; it continued to increase in size and brilliancy up to the second week in October, it was nearest to the earth on the 10th of October, and for several evenings the tail extended more than forty degrees, and on one or two occasions it was traced even to sixty degrees.

The telescope of the Observatory of Harvard College revealed a series of extraordinary phenomena in the region contiguous to the nucleus. On the 20th of September a crescent-shaped outline, obscure and very narrow, was seen interposed, like a screen, between the nucleus and the sun; within this, instead of a softly blended nebulous light, indicative of an undisturbed condition of equilibrium, the fiery mass was in a state of apparent violent commotion. On the 23d two dark outlines were traced more than half way round the nucleus; on the next evening still another, each of these was evidently the outer boundary of a luminous envelope,

the brightest being that nearest the nucleus. On the 25th, four envelopes were seen, and many others have subsequently been formed, almost under the eye of the observer, their motion of projection from the nucleus being evident from night to night. Their process of formation became at last so familiar, that their appearance was on several occasions actually predicted from the condition of the nucleus just before each was thrown off.

A close scrutiny of the tail with the naked eye revealed many curious features scarcely less interesting. The observers at Cambridge were favored with an unusually large proportion of clear evenings during the most important part of the comet's apparition. The observations and measurements are now in process of reduction. W. C. B.

Donati's comet is apparently new to science. Mr. Jas. C. Watson, of the Ann Arbor Observatory, Michigan, furnished the following parabolic elements, Aug. 25, 1858, in Gould's Astron. Jour. No. 116, viz:—

Time of perihelion passage, 1858, Sept.	29·794381,	Wash. m. t.
Longitude of perihelion, -	36° 20′ 11″·5	M. eqx. 1858·0
" " asc. node, -	165 15 49 ·7	
Inclination, - - -	63 3 6 ·0	
Log. of perih. distance, -	9·763374	
Motion, - - - -	retrograde.	

In a communication dated October 2, and published in Gould's Astron. Jour. No. 117, Mr. Watson states that these elements well represent the observations up to the middle of September. After that the discordances between the observed and computed places were considerable, and he therefore prepared, from normal places, for June 11, Aug. 13, and Sept. 25, the following system of elliptic elements. These give a period of revolution of 2415 years, which is necessarily quite uncertain:—

Time of perihelion passage, 1858, Sept.	29·736355,	Wash. m. t.
Long. of perihelion, - -	36° 13′ 6·2	M. eqx. 1858·0
" " asc. node, - -	165 19 11·8	
Inclination, - - -	63 1 27·9	
Angle of excentricity, -	85 24 22·6	
Excentricity, - - -	0·996787	
Log. semi-axis major, -	2 255279	
" perih. dist. - - -	9·762303	

4. *Seventh Comet of* 1858.—The following parabolic elements of the telescopic comet discovered Sept. 5, 1858, at Harvard College Observatory, are furnished by Mr. C. W. Tuttle, assistant, under date of Sept. 14, and published in Gould's Astron. Jour., No. 116:—

Time of perih. passage, 1858, Oct.	17·038128,	Greenw. m. t.
Long. of perihelion, - -	1° 30′ 23″	M. eqx. 1858·0
" " asc. node, - - -	158 58 0	
Inclination, - - -	21 5 47	
Log. perih. dist. - - -	0·15267	
Motion, - - - -	retrograde.	

5. *Total Solar Eclipse of Sept.* 7, 1858.—It will be remembered that Lieut. Gilliss went to Peru in August last, under the auspices of the

Smithsonian Institution, for the purpose of observing the phenomena of the total eclipse of the sun of Sept. 7, 1858. The means for defraying the cost of the expedition were liberally furnished by William Wheelwright, Esq., of Newburyport, Mass. We are gratified to hear that Lieut. Gilliss accomplished successfully the objects of the expedition, and we await with more than common interest the report of his observations.

6. *Shooting Stars of Aug.* 9–10, 1858.—The annual exhibition of an unusual number of shooting stars about the 10th of August, was this year hid from view at New Haven by clouds. The observations below given show, however, that the August meteoric display appeared this year on the usual scale.

(1.) Mr. Francis Bradley, watching alone, while passing from Davenport, Iowa, to Chicago, Ill., observed shooting stars as follows, viz :—

Aug.	9,	from	$10^h\ 45^m$	P. M.	to	12^h	- -	11
"	"	"	12		"	1	A. M. (10th),	28
"	10,	"	1		"	1 45	" - -	21
"	"	"	2		"	3 10	" -	68

Up to about 2 o'clock he could command only about one-sixth part of the sky, and during the last hour about one-fourth or one-fifth. The radiant as usual was in or near Perseus.

(2.) Prof. A. C. Twining, at Cleveland, Ohio, watching alone, observed shooting stars as follows, viz :—

Aug. 10, $0^h\ 5^m$ to $2^h\ 5^m$ A. M., 56, of which 48 were conformable and 8 unconformable. These observations and the following, were made within 30° of arc all around the radiant.

Aug. 10, $8^h\ 30^m$ to 9^h P. M., 11 conformable, and 2 unconformable; the trains long and conspicuous. Radiant had obviously shifted to the West and South.

" 11, $1^h\ 7^m$ to $1^h\ 52^m$ A. M., 26 conformable and 3 unconformable. Sky overcast in patches, and hazy as yesterday.

" 12, $2^h\ 15^m$ to $3^h\ 15^m$ A. M., 30 conformable and 3 unconformable. Sky very clear.

" 13, $1^h\ 30^m$ to 3^h A. M., 20 conformable and 10 unconformable. Sky clear.

" 14, $3^h\ 7^m$ to $4^h\ 47^m$ A. M., 5 conformable and 5 unconformable. Sky clear.

On each occasion the place of the radiant was noted, but can not be accurately stated until verified by an exact star chart.

7. *Falling Stars in August.*—M. Coulvier Gravier has reported as follows on the subject of the August shower. During the present year, he obtained at Paris the following results:

	Horary number, mean at midnight.		Horary number, mean at midnight.
July 14 to 17,	3·2	August 6 to 8,	12·4
" 19 to 21,	9·4	" 9 to 11,	39·3
August 1 to 5,	12·9	" 12,	26·0

Comparing the years since observations began, he finds that since 1848, the number has regularly decreased, the number then was 110 in place of 39·3 of this year. Taking the mean for the three years 1849, 1850,

1851, we find it 85·8; for 1852, 1853, 1854, 57; for 1855, 1856, 1857, it is 44·9; and finally for 1858, only 39·3. It is to be said, however, that this result is not confirmed by observations elsewhere, or at least is not evident from them.—*L'Institut*, xxvi, 271, *Aug.* 1858.

8. *Meteoric Stone from near Mainz.*—The analysis of this stone by F. Seelheim (J. f. pr. Chem., lxxiii, 235) afforded, soluble gelatinizing silicate 52·23 per cent, insoluble silicate 39·26 p. c., other ingredients 8·56.

Soluble gelatinizing silicate (52·23 per cent) consisted of S̈i 15·74, Ṁg 16·12, Ṅi 2·08, Ḟe 18·29 (oxygen ratio of silicates for Ṙ : S̈i=10·94 : 8·17).

Insoluble silicate (39·26 per cent) S̈i 20·96, Ä̇l 13·49, Ḟe 3·60, K̇ 1·21 (oxygen ratio for Ṙ, R̈, S̈i=1 : 6·3 : 10·9.

Other ingredients (8·56 p. c.) FeS² 3·86, nickeliferous iron 2·13, C̈r 0·46, P̈ 0·60, Ḧ 1·51, Cu, Sn, Mn, Ċa, *traces.*

The stone has the specific gravity 3·44; H.=5; BB. edges rounded. Appearance in part like an altered olivine; color dirty yellowish-brown; granular.

V. MISCELLANEOUS SCIENTIFIC INTELLIGENCE.

1. *The Aquarian Naturalist, a Manual for the Sea Side*; by Thomas Rymer Jones, F.R.S. 524 pp., 12mo, with 8 colored plates. London, 1858. Van Voorst.—This is an excellent work, whether considered as to its literary, scientific or artistic merits. The aquarian naturalist will find it a most agreeable and instructive companion; and all interested in the wonders, beauties and truths of the world of life will read it with pleasure and profit. The author is distinguished among the men of science of England. We cite a few paragraphs from the work:—

"*Arenicola Piscatorum*—'*The Lug.*'—Every visitor to the sea-coast must have remarked certain places on the shore, near low-water mark, almost entirely covered with little pyramids or mounds formed by coils of sand or mud, the '*castings*,' as they are called, of worms. All these little heaps are produced by an animal lurking at a considerable depth beneath the surface, named in scientific language *Arenicola piscatorum*, and known by fishermen, who find in it a valuable bait, as the *Lug-worm* or the *Lug*. There can never be any difficulty in procuring specimens of these worms, if only care be taken to dig deep enough, the spade being driven to the depth of at least a foot and a half into the sand, otherwise the animal will certainly be broken.

When dug up entire, this beautiful Annelidan is found to be about ten inches in length, and in some parts nearly half an inch in thickness, its body being cylindrical, and made up of very numerous segments towards the posterior part. However, it becomes suddenly reduced in size, and assumes quite a different appearance, as if more uniform in structure, and presenting a shagreen surface. A double row of bunches of setæ project from the sides of the animal, and thirteen pairs of beautiful vermilion-colored tufts rise from the back, commencing at about one-third of the length from the anterior extremity; these last-named organs, which constitute the respiratory apparatus, are extremely elegant, and when examined with a simple magnifying-glass resemble arborescent shrubs, the stems, boughs and branches of which are all in lively action.

The diversity of color in this species is very great: of a number collected together, some will be found of a carmine hue, or of a still deeper red, some brownish, and others blackish green, or all these shades are sometimes blended together in the same individual.

Dwelling constantly in the dark, not only deep in the sand, but generally covered by the sea, the Arenicola is extremely impatient of light, and when in confinement continually attempts to penetrate downwards, even when there is no sand in the vessel; but if amply provided with this material, it soon screens itself from view.

The *Arenicola piscatorum* connects the naked with the sedentary Annelida. A viscid secretion exudes from the anterior half of the animal, to which the sand adheres, and hence, when the worm is dug up, this part is generally found to be covered with an imperfect arenaceous tube, within which the movements of the worm are performed with perfect freedom, but which can not be removed entire, on account of its extreme fragility. This tube is, in fact, left behind as the animal progresses, and forms a complete lining for the hole, which, like the brickwork of a well, it supports, and keeps pervious throughout its whole length. The creature is thus enabled to ascend readily to the surface, and the water is admitted freely to the branchiæ.

A few of the anterior rings of the Arenicola progressively diminish in size, and each admits of being completely folded within the ring immediately behind it. Hence, when they are fully retracted, the anterior extremity of the animal appears abruptly truncated; while it is prolonged in the shape of a regular cone when they are projected to an extent just short of developing the mouth. This constitutes its boring apparatus. The rings being retracted, the flat head of the Arenicola is directed against the sand, and then the forcible projection of the cone opens a passage for the rest of the body. The opening thus made would, however, be insufficient, and the delicate branchiæ might be injured while forced through such a narrow passage; but, to avoid this, the animal immediately on completing the penetration distends the penetrating rings very considerably. By the advance of the body the opening thus enlarged is then occupied, and the rings being again received into each other, the cone is ready to be again projected. During the progress of the animal, the glutinous secretion which exudes from it cements together the surrounding sand, and gives that support to the sides of the hole, without which it would immediately fall in.

It is not, however, simply for the purpose of excavating a retreat that the Arenicola thus pioneers beneath the soil—the sand amongst which it works is devoured and swallowed as the worm bores its way: not that the sand itself is nutritive, or can be used as food, but the organic matters mixed up with it—the last scrapings, as we might say, of the platter,—are thus made useful, and become assimilated as the earthy medium traverses the alimentary canal, and it is finally rejected in the form of the sand-coils which betray the retreats of the "lugs" on every sea-beach.

The Arenicola seems to be a favorite article of food to all sorts of marine animals of carnivorous appetite: not the apple of Discord itself stirred up such sanguinary battles, nor was the body of Patroclus more stoutly fought for by the rival Greeks and Trojans than one of these

worms, when offered as the prize of fight among the multifarious combatants ready to claim their portion.

In order to study the mutual hostilities of these warlike races, M. Quatrefages threw a large specimen into a pool a few feet wide. A troop of shrimps at first, scared by the sound, darted away; but these soon rallied, just as the Annelid was about to bury itself in the sand, when one, more daring than the rest, grappled it by its middle. Thus emboldened, others lost no time in prosecuting the attack, and the poor worm was pulled about in all directions, till a full-grown pawn, rushing from behind a tuft of coralline, dispersed his feebler comrades, and appropriated the booty to himself. It was, however, at once seen that he would speedily be forced to share the spoil, for at that very instant there appeared some score of Turbos and small Whelks, who, conscious that a dinner was at hand, all hastened up, evidently for the purpose of participating in the feast. Without any sign of uncertainty or hesitation they moved straight forward toward the anticipated meal, and the worm was soon covered with these predatory mollusks. The fate of the contested prey seemed definitely settled, when a small Shore Crab (*Carcinus Mœnas*), issuing from underneath a stone, soon put to flight the shrimps, and, by dragging off the Arenicola, very nearly upset all the Turbos, who forthwith retreated gladly to their sandy haunts. Then, however, a large edible Crab (*Cancer Pagurus*) appeared upon the scene, and the poor little *Mœnas* was obliged in his turn to beat a retreat, in order to escape out of the reach of the formidable pincers of his stronger kinsman. Still he kept a watchful eye over the dainty morsel which he had once tasted, and taking advantage of a moment when the larger crab was withdrawing from the field from some temporary emotion of alarm, he rapidly seized the long-disputed Arenicola and carried it for safely to some distance from the water's edge, where he might devour it at his ease upon dry ground, and thus put an end to the combat."

Speaking of *star-fishes*, he says:

"In confinement these creatures are almost invariably subject to frightful mutilations. Not only do they lose large portions of their body, or even entire rays, but the whole animal sometimes literally falls to pieces; nay, although to-day you may possess a complete and beautiful specimen, which has behaved itself in a manner perfectly correct and satisfactory, there is no saying but that to-morrow morning you will find nothing left of it but a heap of fragments dispersed through the water. This kind of suicide is a casualty apparently incidental to the whole race, and with some species, amongst which *Luidia fragilissima* stands preëminently conspicuous, it is so generally put in practice, and that upon the slightest occasions, that to procure one in an entire state is almost impossible.

Prof. E. Forbes, often baffled by this suicidal habit, upon one occasion was induced to take special precaution against it; he accordingly provided a bucket of fresh water to receive and kill instantaneously any that might be caught by the dredge, and a very amusing account he gives of the ill-success of the experiment. 'As I expected, a *Luidia* came up—a gorgeous specimen. As it does not generally break up before it is raised above the surface of the sea, cautiously and anxiously I sank my bucket to a level with the dredge's mouth, and proceeded, in the most gentle

manner, to introduce Luidia to the purer element. Whether the cold element was too much for him, or the sight of the bucket too terrific, I know not, but in a moment he proceeded to dissolve his corporation, and at every mesh of the dredge his fragments were seen escaping. In despair I grasped the largest, and brought up the extremity of an arm with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision.'*

We are reminded by the concluding sentence of the preceding facetious quotation, that, in order to explain the allusion made by our late lamented friend to the 'terminating eye and spinous eyelid' of the Star-fish, it will be necessary to say a few words concerning the senses of these extraordinarily gifted creatures. That they do perceive what is going on in the world around them, at least in so far as their own business is concerned, there cannot exist a doubt; nay, that their perceptions are acute and rapid, any one who has witnessed the facility with which they find and devour a bait, or a morsel of food, will readily allow; but how they are enabled to effect this is by no means so easily explained. That it must be by some sense analogous either to smell or vision, seems pretty evident; but where we are to look for their noses or eyes is a problem not of very easy solution. In many species, however, there are found, situated at the extremity of each ray, certain bright red spots, very conspicuous in the living animal, around which the terminal spines cluster, as though for their protection. These red spots are by many eminent naturalists regarded as the eyes of the Star-fish, and the surrounding spines constitute the eyelid above alluded to. How far they are or are not instruments of vision, is a matter still open to dispute, and a question well worthy of solution by any of our readers, whose opportunities enable them to make experiments upon this interesting subject."

2. *On the Application of Electricity in Local Anæsthesis in Tooth Drawing*, (Athen., 1611, p. 334.)—The application of electricity for producing local anæsthesis in tooth drawing, is creating a considerable sensation. The *modus operandi* is thus described by Mr. Kincely Bridgman, of Norwich. The apparatus is simple, and consists principally of the common electro-magnetic machine used in medical electricity, a single cell and pair of plates constituting a Smee's battery, and a small electro-magnetic coil with a bundle of wires for graduating the strength of the current. One end of the thin wire conveying the secondary current is attached to the handle of the forceps, and the other end of it to a metallic handle to be placed in the hand of the patient. The instrument touching the tooth completes the circuit, and the current passes instantaneously. The wire attached to the forceps should be made to pass through an interrupting footboard, so that the continuity of the wire may be made or broken in an instant by a movement of the right foot of the operator. The advantage of this arrangement is, that it allows the instrument to be placed in the mouth without risk of producing a shock in coming in contact with the lips, cheeks, or the tongue, which would interfere with the quiet of the patient. A hole drilled in the end of the left handle of the forceps, and the end of the wire tapered to fit rather tightly allows the substitution of one pair of forceps for another with

* Forbes's British Star-fishes.

scarcely a moment's delay. The importance of this subject is so great that numbers will, doubtless, immediately have recourse to it, so that we may soon expect its real merits to be fully ascertained.

3. *On the Atlantic Cable;* by William Gravatt, Esq., F.R.S., F.R.A.S., (Edinb. Phil. Mag. and Jour., xvii, p. 34.)—I considered this subject, and, as is well known, arrived at my conclusions long ago; and notwithstanding the conclusions I see were come to at the last meeting of the British Association and at other meetings, and notwithstanding the Astronomer Royal's two papers on the subject, I feel that my original conclusions are unshaken.

The subject is of great importance, and I will (if you will allow me) give you as brief an abstract of my ideas as I possibly can.

I have demonstrated (but without a diagram it is almost impossible to give the demonstration) that if a vessel be running in a straight course at any uniform speed whatever, and the cable is being paid out over the stern at the same velocity, then, in the case where the strain tending to break the cable as it leaves the stern is just equal to the weight in water of a portion of the same cable, whose length is the depth of the sea, the cable will be at any instant in the same condition as to tension and pressure as if it were simply lying straight on an inclined plane surface immersed in water; there will be no strain whatever on the particle which happens at any instant to be the bottom particle of the cable, and the cable will therefore sink down in a vertical plane with uniform velocity, and be laid (not stretched) straight along the bottom of the sea without any waste.

Let

α=the angle the cable forms with the horizon.

t=the terminal normal velocity in feet per second, or the velocity of the cable at right angles to its length.

V=the velocity of the ship in feet per second.

w=the weight in pounds of one foot of the cable, in water.

d=diameter of the cable in feet.

D=the depth of the sea in fathoms.

L=length in fathoms, from the stern of the ship to where it touches the bottom of the sea.

Now the resistance expressed in pounds to each foot in length of a rough cylinder moving sideways in sea water is $\cdot 8dv^2$ pretty nearly (d being the diameter in feet, and v the velocity in feet per second).

We must have therefore $w \cos\alpha - \cdot 8dt^2 = 0$, or $t = \sqrt{\frac{w \cos\alpha}{\cdot 8d}}$.

We must also have $V = \frac{t}{\sin\alpha} = \frac{1}{\sin\alpha}\sqrt{\frac{w \cos\alpha}{\cdot 8d}}$, and also $L = D \operatorname{cosec}\alpha$.

Now, taking as an example $w = \cdot 32$ and $d = \cdot 05$, as is pretty nearly the case in the present Atlantic cable, we get

$$\log t = \tfrac{1}{2}(\log 8 + \log \cos\alpha),$$
$$\log V = \tfrac{1}{2}(\log 8 + \log \cos\alpha) - \log \sin\alpha.$$

From whence, taking $\alpha =$ successively 10°, 20°, &c., we get immediately the following Table, which we can easily extend:

Values of α.	Velocity of ship in feet per seconds.	Velocity of ship in knots per hour.	Values of L when D is taken unity.	Terminal normal velocity in ft. per sec. or values of t.	Tension in pounds on leaving the ship, the depth of the sea being D in fathoms at 2 lbs. to the fathom.	Tension at the bottom.
10°	16·18	9·71	5·76	2·81	2D	0
20	8·02	4·81	2·02	2·74	2D	0
30	5·26	3·16	2·00	2·68	2D	0
40	3·85	2 31	1·56	2·48	2D	0
50	2·96	1·78	1·30	2·27	2D	0
60	2·31	1·39	1.15	2·00	2D	0

Note.—The slip is obviously V vers α in feet per second, giving a resistance (as will be afterwards shown) of ·012 (6V vers $\alpha)^{1\cdot8}$ pounds per fathom, or ·012 (6V vers $\alpha)^{1\cdot8}$ L pounds on the whole, which ought in strictness to be subtracted from the weight of D, but which is too small a quantity to be noticed in practice, at least in any cable similar to this.

Now, taking the greatest depth of the sea to which the cable in question is to be exposed at 2000 fathoms, and each fathom to weigh in water $6\times\cdot32=1\cdot92$ lb., say 2 lbs. per fathom, we have 4000 lbs. for the strain on the cable, whatever may be the velocity of the ship; or as the cable is said to break with about $4\frac{1}{4}$ tons or 9500 lbs., the greatest necessary strain in smooth water is about four-tenths the breaking weight.

But if the cable be paid out at a greater velocity than the horizontal velocity of the ship, the cable will be (so to speak) slipping down the supposed inclined plane, and we must, in that case, find the resistance due to that slipping velocity.

Now this resistance is not exactly as the square of the velocity, nor is it indeed exactly as the diameter of the cable.

Upon the whole, I consider from a comparison of experiments, principally those of Colonel Beaufoy, that when the velocity in knots per hour is v, the resistance in pounds per fathom will, for the cable here supposed, be nearly enough represented by $\cdot012v^{1\cdot8}$.

For the sake of brevity I shall take only the example of this cable at an angle of 20°, where the velocity is, we see, 4·8 knots per hour. Now, taking the depth of the sea at 2000 fathoms, we have L=D cosec α $=2000\times2\cdot92=5840$ fathoms.

Taking, for example, the slipping velocity of the cable equal to the velocity of the ship, or paying out twice the necessary length of cable, we find for a slipping velocity of 4·8 knots per hour, a resistance of about ·2 lb. per fathom, or the total slipping resistance of the cable 1168 lbs., by which amount the strain on the cable at the ship's stern will be reduced, or the greatest strain will be $4000-1168=2832$ lbs., or to reduce the strain little more than one-fourth, we should at this velocity have to waste half the cable. Again, a waste of one knot of cable per hour, or a little more than 20 per cent of the cable, would only reduce the strain about 70 lbs.

From the above, it appears that we are not able materially to reduce the strain upon the cable without occasioning excessive waste, unless at 'Leviathan' speed.

Now if, on the other hand, we increased the tension of the cable beyond that due to the simple depth of the sea, the cable would form a curve

concave to the horizon, and we might find the form of this curve when the strain was 2D, 3D, or any multiple whatever of D; but it would be so very bad engineering to *stretch* or *strain* a cable over the bottom of the sea, when we ought, on the other hand, really to allow waste (according to circumstances) to sink into its irregularities, that although I have considered this state of the cable, I think it practically necessary to observe only, that if from any accident the paying out of the cable is obliged to be discontinued, then, in order to avoid a catenarian strain that might be fatal, the motion of the ship should instantly be reversed, and if in very deep water she should run back until the cable hung vertically, or nearly so, a distance which is expressed by $D - L \operatorname{vers} \alpha$ or $D\left(1 - \frac{\operatorname{vers} \alpha}{\sin \alpha}\right)$.

A cross current could only curve the free part of the cable sideways without adding to the strain, or occasioning waste, as we readily see if we recur to the idea of the cable lying upon the supposed inclined plane surface; for although we made it curve in any manner by pressing against it sideways, it would, as before, be prevented from slipping down by the weight of a portion of the same cable, whose length was the perpendicular height of the plane.

I may just remark, that if the ship moved with an accelerated velocity, the cable would form a curve with the convexity upwards, and on the other hand, if she moved with a retarded velocity, the cable would form a curve with the convexity downwards.

With a brake-apparatus properly contrived and worked by practised *seamen*, the sending and pitching of the vessel in moderate weather ought not materially to increase the strain on the cable, and the nearer the brake-apparatus can be made to approach in its *action* that of (that exquisitely delicate and simple apparatus) the fly-rod and winch when in the hand of a *fisherman*, the more perfect it will be.

Whilst for very great depths it is very proper to consider the means we have, or may find out, of forming efficient cables of small specific gravity, yet, on the other hand, we ought not to forget that in steel we have a material whose modulus of tension is 6,700 fathoms, whilst for iron wire the modulus is only 4,000 fathoms.

The subject is very interesting, and I could go on much further, but that I fear I have already trespassed too much on your valuable space.

4. *On the Submarine Plateaus of the East Indies;* by George Windsor Earl, M.R.A.S., (Jour. Indian Archipelago and Eastern Asia, [2], ii, 278.)—The Banks of Soundings (as they are termed by seamen) which extend from the continents of Asia and Australia towards each other, form very remarkable features in the physical geography of this part of the world, and, as such, became a subject of interest to the author of these papers more than a quarter of a century ago. The investigation which followed, resulted in enabling him to classify the islands of the Indian Archipelago, distinguishing the *Volcanic* bands from the older formations, and there, he thought, the practical utility of the enquiry would end; but, within the last few years, the depths of the ocean have become of interest to others besides seamen and geographers, and the

section-map which accompanies this paper will probably be acceptable to those men of science who are desirous of connecting Australia with the older continents by telegraphic wires. The map was printed nearly two years ago, for the purpose of illustrating a subject in no way connected with electric telegraphs, but in these utilitarian days the speculative must give way to the practical, and the writer will be well satisfied if the paper now produced assists and encourages the enterprise even in a small degree.

The Asiatic Plateau.—The Asiatic Plateau or "Bank of Soundings" extends from the south-eastern extremity of the continent nearly twelve hundred miles in a direct line towards Australia. It is bounded to the west and southwest by the islands of Sumatra and Java, the outer coasts of which are steep-to, shelving off rapidly to a depth which is unfathomable by the ordinary sounding apparatus in use on board ships. Borneo and the southwestern limb of the island of Celebes lie on its eastern verge, and the extremity nearest to Australia is occupied by a group of islands extending from the southern limb of Celebes, of which Salayer and Kalatoa are the principal. The boundary of the plateau to the northeast is not so distinctly defined. It skirts the east coast of Cochin China throughout its length, and extends from it into the China Sea in a southerly direction for a distance of two hundred and fifty miles, when it is lost among the extraordinary cluster of coral reefs which occupies the remainder of the space between the coast of Cochin China and the islands of Borneo and Palawan—unless we assume that this same cluster of coral reefs is formed on a more deeply submerged portion of the plateau, an assumption which is favored by the fact that the southern boundary of the plateau, which extends from the east end of Java to the island of Kalatoa is also skirted by coral reefs, which probably would have formed a "barrier" like that which bounds the Australian plateau in the Pacific, had circumstances been equally favorable to the development of coral formations.

The average depth of the sea over the plateau is from 28 to 30 fathoms, and rarely exceeds 45 fathoms except near the verges where the soundings necessarily become irregular. The bottom is of the same character throughout, except in spots where currents have swept and exposed the granite or iron stone rock, and here the coral insect will generally have established itself. Elsewhere the bottom consists of a clayey mud, mixed with sand and shells, which is soft enough while under water, but when taken up and dried gradually in a mass, hardens to such a degree that it can not be broken up without the aid of a pickaxe.

No traces of volcanic action have yet been detected on any part of the plateau, the rocks and minerals being all connected with the older formations. It is, however, more than probable that the irregularities of surface that are met with near the northeastern verge in the China Sea, and towards its extremity at Kalatoa, will have been produced by the volcanic convulsions that have taken place in the immediate vicinity.

The extreme length of the submarine plateau, measuring from the head of the Gulf of Siam is 1,700 miles, and its greatest breadth about 800 miles.

The Australian Plateau.—The submarine plateau which extends from the north and northwest coasts of Australia, although covering a space

at least equal to that of the Asiatic plateau, never reaches to a greater distance from the coast than 450 miles, and that only at one point. It is bounded on the east by the Great Barrier Reef which rises abruptly from the depths of the Pacific,—on the north by New Guinea, the Aru Islands and Timor Laut,—and on the northwest by Timor and by an irregular line extending from that island to the Northwest Cape of Australia. The Barrier Reef which forms the eastern boundary, is a natural sea-wall of surprising strength and solidity, and doubtless owes its existence in so compact a form to the circumstance of the coral insect only attaining its full development when incessantly washed by the clear waters of the open ocean. In every other respect, the Australian Plateau is identical in its character with that of Asia. The depth of water is of the same average; the nature of the submerged surface of the plateau is precisely similar; and there is the same tendency to coral reefs and other irregularities near the line where the plateau disappears in the depths of the ocean. The general character of the islands included within the area of the plateau is also the same, no recent volcanic formation having as yet been detected.

The Volcanic Gorge.—All the islands of the Indian Archipelago which are not included within the submarine plateaus defined above are of volcanic origin, and the greater number of the larger islands contain volcanoes in a state of activity at the present time. The seas which bound them are unfathomable by the apparatus in ordinary use on board ships, partly owing to the depth of the ocean, and partly to the strength of the currents, which seem to increase in velocity as the sounding lead descends, but this may be merely imaginary. It is certain, however, that there is a constant current setting in from the Pacific Ocean round the northwest end of New Guinea, (partly caused by the easterly trade wind, and partly, perhaps, by the revolutions of the earth from west to east) which can find no other outlet to the Indian Ocean except through the channels which lie between Kalatoa and Timor. These islands are distant apart exactly 180 miles, which may be considered as the width of the Volcanic Gorge at this, its narrowest, part. This space will have to be sounded before a telegraph cable can be laid down with safety, for although I am of opinion, taking as a criterion the slope of the land on each side of the channels between the islands, that the depth of water will never exceed 1000 fathoms, it may possibly be considerably more.

[The map is omitted. A boundary line marking the limits of the Asiatic plateau extends eastward from the northeast cape of Java to Kalatoa, leaving Floris and other islands east of Java in the deep sea south. From Kalatoa, it bends northward to Celebes. The boundary line of the Australian plateau passes around Timor so as to include it, and then westward and northward just north of Timor Laut, to New Guinea at the parallel of 5°.—Eds.]

5. *Alum in China;* by Dr. Macgowan.—About eleven hundred tons of alum have been exported within a short period, chiefly to India. This mineral is largely employed by the Chinese in dyeing and to some extent in paper-making as with us. Surgeons apply it variously after depriving it of its water of crystallization, and in domestic life it is used for precipitating vegetable substances suspended in potable water.

It is used also by the Chinese in a manner peculiar to themselves. Fishermen are usually provided with it, and when they take one of those huge Thizostoma which abound on the coast they rub the animal with the pulverized styptic to give a degree of coherence to the gelatinous mass. Architects employ it as a cement in those airy bridges which span the watercourses. It is poured in a molten state into the interstices of the stones; and in structures not exposed to constant moisture the cohesion is perfect, but in damp situations it becomes a hydrate and crumbles, a fact of which the whole empire was officially informed by the government about thirty years ago. It was discovered that water had percolated into the mausoleum of Kiaking; having been built too near to the mountain side, the alum cement imbibed moisture, segregated and opened the way for to enter the tomb. In those peaceful days such an event was of so great importance as to call forth edicts and rescripts, memorials and reports in succession for several months. The son-in-law of the deceased monarch, to whose care the construction of the edifice had been entrusted, was fined and degraded, and a statesman from Foh-kien acquainted with the properties of alum, was appointed to remove it a short distance from the mountain.

Alum was first introduced into China from the west, and until a comparatively recent period the best kind called sometimes Persian, and at others Roman Alum, was brought from Western Asia. Numerous localities where an inferior article is manufactured, are mentioned in the Pharmacopœia—*viz*: Shan-tung, Shan-se, Kiang-su, Hu-kwang, Sz'-cheun, and also in the southwestern frontier and in Thibet. That from Sz'-chuen, is represented as having the property of converting iron into copper, or of coating iron with copper, by placing the former metal in a solution of rice-liquor and alum the stone of that province. The most recent editions of works on materia medica, contain no reference to the mines in this province, the products of which have surpassed in quality the foreign, and rendered its importation unnecessary. From this and from other circumstances, it is certain that the works which we shall now describe have not been long in operation. They are in the Sung-yang hills bordering on Foh-kien in the district of Ping-yang, Wan-chau prefecture, and in close proximity to Peh-kwan harbor (27° 9′ 10″ N., 120° 32′ 6″ E.)

The locality has been visited by one foreigner only, to whom we are indebted for most of the following particulars. About two months ago he started from Chih-k'i bight in Lannai harbor, to which Ningpo boats resort for this commodity to the northward of Peh-kwan. Three hour's hard walking over a succession of precipitous hills crossed by stone steps and pathways brought him to the mines. Ten alum-making establishments were in operation, which, with the exception of one on a hill opposite, occupied about a mile of the side of a lofty hill. The works were adjacent to the quarries from which the alum-stone seemed to crop out of decomposed rock of the same lithological character. The stones were thrown into a fire of brushwood, where they were burnt with a slight lambent flame, and as they cracked, the fragments were raked out, broken into small pieces, and macerated in vats. Subsequently the disintegrated mineral was thrown with water into a vessel having an iron bottom and sides

of wood, and boiled for a short time. The lixivium was then poured into large reservoirs where it crystallized into a solid mass. Blocks of alum weighing about fifty catties each, were hewn out of the reservoir and carried in this state in bamboo frames, one on each end of a porter's pule to the place of shipment, where it is broken into fragments. When not designed for immediate exportation the blocks are stored away for drying. On reaching the depot the alum is found charged with a double quantity of moisture, the porters being obliged to deliver a certain weight, they slip their burdens in the mountain streams which they pass in the journey.

Judging from the number of laborers engaged in transporting the mineral on the day of our informant's visit, the quantity brought from the works could not be less than eighteen tons. This was represented as less than an average day's work, as labor was in such demand just then for agricultural purposes, that double pay was given;—and aged men, and women, with boys and girls were pressed into the service. Assuming that day's product as a basis for calculation, and making an allowance for rainy days, we may safely estimate the annual supply as between five and six thousand tons. The quantity consumed by the dyers of Ningpo prefecture alone, being nearly twenty-two tons per annum is corroborative of this estimate. The supply is literally inexhaustible. Five dollars and a quarter a ton at the landing, would afford the manufacturer a fair profit. It often fetches much more, as there has been an increasing demand for the article, owing to the greater facilities afforded for exportation from Ningpo in foreign vessels.

6. *Report of the United States Mexican Boundary*, made under the direction of the Secretary of the Interior, by William H. Emory, Major First Cavalry, and United States Commissioner. Vol. I, 4to. Washington, 1857. Executive Document, 34th Congress, 1st Session, No. 108.—This first volume of the Report by Major Emory, on the region along the boundary between Mexico and the United States, has great general interest. The careful descriptions of the plateaus and mountains, and the effective landscape sketches, give the eyes of the traveller to the reader, and will especially attract the physical geographer. The accounts of the natives and the colored sketches, add to our former knowledge on the habits and condition of the Indians. The Geological Reports make up a large part of the volume, and greatly increase its value. There are, first, the Geological Reports of Dr. C. C. Parry, and Assistant Arthur Schott, followed by notes by Major Emory. Then follow the Palæontology and Geology of the boundary by James Hall, and description of Cretaceous and Tertiary Fossils, by T. A. Conrad. This geological part is illustrated by twenty-one 4to plates of fossils from figures drawn by Mr. F. B. Meek, and also by sections and a Geological map of the region west of the Mississippi, by Prof. Hall, assisted by J. P. Lesley.

Eocene shells of the age of the Claiborne formation, were obtained by Mr. Schott in western Texas, at Arroyo Las Minas, between Eagle Pass and Leon.

7. *Prodromus Descriptionis Animalium Evertebratorum*, &c.; by W. Stimpson. Part VI, Crustacea Oxystomata of the North Pacific Expedition. Mr. Stimpson here mentions thirty-one species of Crustacea Oxystomata, including eleven that are new, and the four new genera, *Carcinaspis*, *Cryptocnemus*, *Onychomorpha*, and *Tymo.us*.

8. *Chemical Analysis of the Scales of the Striped Bass (Labrax lineatus);* by Mr. JOHN GREEN, (Proc. Bost. Soc. Nat. Hist., vi, p. 374, 1858.) Scales dried at 212° F., afford 45·9 per cent of ash. 100 parts of ash contained of lime 48·36; of magnesia ·99; of phosphoric acid 50·65. This result is identical with the composition of bone ash. The structure of bone is different in the Ganoid fishes from that of any Cycloid or Ctenoid, and confirms the differences already established from the appearances of the scales. The scales of the Amia of the western waters, contain bone corpuscles of the same form and appearance as those of Megalops and Lepidosteus, showing a new analogy of Amia with Ganoid fishes.

9. *On the Rate of Growth of Coral;* by T. LYMAN, (Ib., p. 374.)—Mr. Theodore Lyman, referring to a large fragment of Madrepore Coral, taken from the wreck of a British man-of-war, and which he had exhibited at a recent meeting, said that he had since ascertained that the vessel was lost about the year 1806, or half a century since. The incrustation of the coral around the iron bolt, shows that the diameter of the coral must have been about three inches, and such a shaft, he supposes, would have supported a very high stem, so that the rate of growth might have been perhaps half an inch a year.

10. *First Principles of Physics or Natural Philosophy;* 720 pages, 12mo, with 672 wood-cuts; by BENJAMIN SILLIMAN, Jr., M.D. 1858. Philadelphia, Peck & Bliss.—This text-book was prepared for the use of academies and colleges. It takes up all the departments usually included under the term of Natural Philosophy,—General Properties of Matter, Crystallography, Gravitation, Mechanics, Machines, Hydrostatics, Hydraulics, Acoustics, Heat, Optics, Magnetism. Electricity, Meteorolgy, etc., etc. The topics are treated in a simple manner, without going into abstruse mathematical demonstrations, and with the introduction of whatever of a practical nature would increase its value as a class book. The illustrations are very numerous and well engraved.

11. HANSTEEN.—The University of Christiana has had a medal struck in honor of the 50th anniversary of the professorship of the illustrious Hansteen, one of its members, whose labors, connected especially with terrestrial magnetism, are well known to the world.—*L'Institut, June,* 1858.

12. THE MATHEMATICAL MONTHLY, edited by J. D. Runkle, A.M., 28 pp., small 4to, Cambridge.—The first number of the Mathematical Monthly appeared in October. We can best give an idea of the character of the work, to which we wish great success, by quoting the list of papers:

Note on Decimal Fractions, by Rev. Thomas Hill; Rule for finding the Greatest Common Divisor, by Pliny Earle Chase; Note on Equation of Payments, by G. P. Bond; On the Study of Geometry, by Samuel P. Bates; Demonstration of a Theorem, by Pike Powers; Demonstration of the Pythagorean Proposition, by James Edward Oliver; Note on Napier's Rules, by Truman Henry Safford; Problem, by Prof. Peirce; On the Relation between the States of Minimum and Equilibrium, by John Paterson; Note on Derivatives, by Rev. Thomas Hill; Propositions on the Distribution of Points on a Line, by Prof. Benjamin Peirce; Virtual Velocities, by William Watson; The Prismoidal Formula, by Chauncey Wright; Ovals and Three-Centre Arches, by J. B. Henck.

13. *Black's Atlas of North America.*—A series of twenty Maps, constructed and engraved by JOHN BARTHOLOMEW, with introductory letter-press and a complete index. Edinburgh: Adam & Charles Black, 1856. Demi-folio.—This is an excellent series of maps, neatly engraved and bearing evidence of a careful study of late authorities of North American geography. The grouping of subjects in the maps is judicious and tasteful. The eighteenth map, including California, Oregon, Utah, Washington, New Mexico, Nebraska, Kansas, the Indian Territory, &c., is the best exhibition we have seen of the recent results of explorations in the great central and northern regions of the continent. The price of the atlas is very moderate, (16*s.* sterl.) It is imported in large quantity by Messrs. Little, Brown & Co., of Boston.

14. *Systematic Philosophy, and New Theories of Light amd Heat;* by GEORGE FELLOWS HARRINGTON. 108 pp. 8vo. London, 1857.—This is an interesting work, but novel in its views; and so far as it is novel it is at variance with accepted philosophy and what we regard as established truth in chemistry and physics. In an appendix, the author writes as follows on the open polar sea:—

"The open sea, thus discovered and spoken of by Dr. Kane, extending northward from the 80°, proves the existence of a milder climate than is found a few degrees to the south; and as the climate gradually becomes milder northward, probably, from the 75°, there must be a process going on at or near the pole, to generate heat sufficient to affect the temperature of the climate, or water would not be found in a fluid state beyond the 80° of north latitude—a distance of nearly seven hundred English miles from the pole itself. I am at a loss to know what the process can be which produces such heat, unless it is generated by the inflammation of the electricity necessary to feed the flaming *aurora borealis*, as already described. And if the heat there existing is produced by these means, so as to be palpably felt at the distance of seven hundred miles from the centre of the fire, what must it be at the pole itself?"

15. OBITUARY.—*Death of Professor* PARKER CLEVELAND, *of Bowdoin College, Brunswick, Maine.*—This eminent author and teacher has been long known as one of our most distinguished and useful professors of science. He was born in the town of Essex, Mass., January 15, 1780, and was graduated with high honors in Harvard in 1799. Among his distinguished classmates were the Hon. Samuel D. Parker and General William H. Sumner of Jamaica Plain.

Appointed to a tutorship in Harvard in 1803, he held the office only two years, when he accepted the Professorship of Mathematics, Natural Philosophy, Chemistry and Mineralogy in Bowdoin College—four professorships as they are usually arranged in European universities—a heavy load for one man, but it was sustained by him with distinguished ability and success until he was relieved of a part of his duties by the appointment of a Professor of Mathematics; he continued in the other branches until his lamented death October 16, 1858, at the age of 78–9. He was a member of the American Academy of Arts and Sciences, of the Philosophical Society, and of the Maine Historical. He was an honorary member of the Geological Society of London, and of several other learned societies in Europe. In 1824 he received the degree of LL.D. from

Bowdoin College. His moral character was pure, his social dispositions amiable and genial, and his manners affable, warm and winning, especially in his domestic relations.* Professor Cleveland was, for a long course of years, a member of the Congregational Church in Brunswick, and a firm believer in divine revelation.

The senior editor of this Journal first became acquainted with Professor Cleveland in 1814. His reputation for zeal, industry and learning and his success in the cultivation and diffusion of science were even then conspicuous. The department with which his name has been most intimately connected is that of Mineralogy; and his work on this subject gave him deservedly a high reputation throughout the land. The first edition was published at Boston, in 1 vol., 8vo, pp. 670, in 1816, and a second edition, in 2 vols., 8vo, in 1822. It was constructed upon the plan of the Treatise of Alexandre Brongniart of Paris, and like that admirable work it was lucid in statement, rich in facts and attractive in style. A sketch of geology was annexed, as an appendix to mineralogy; for geology was then beginning to be cultivated in this country.

The entire work was received with great approbation. A third edition was announced, as it was much desired, but it did not appear, although the author never relinquished the purpose of revision and republication. It was, doubtless, prevented by his onerous duties in the college and by a severe neuralgic affection, which occasionally visited him with sudden and severe pain in his eyes and head—usually vanishing like a lightning flash as it came. Protracted night studies doubtless aggravated the difficulty.

Professor Cleveland travelled very little; his sphere of original observation in the field was therefore limited, but he made the best use of the opportunities which he enjoyed, and derived much information from an extended correspondence with his scientific friends.

His natural ardor and activity were very great; they were tempered by an excellent judgment and a chastened taste, rendering his writings models of a pure English style. It is much to be regretted that such a man should have been so much withdrawn from original research by the exhausting toil of incessant college duty. Professor Cleveland was well able to have filled a more extended sphere. His talents as a lecturer and teacher were of a high order; his enthusiasm burned bright through half a century and was imparted to his numerous and admiring pupils. He was spared to a good old age, and left a name which will be long honored and revered.

Three eminent professors have departed almost together: Dr. Robert Hare, late professor in Philadelphia, Professor Ira Young, of Dartmouth College, and Professor Cleveland, of Bowdoin. B. S.

Wm. Baird, M D., F.L S.: A Cyclopedia of the Natural Sciences, 8vo, Glasgow, 1858.—The Annals and Magazine of Natural History of London speaks of the work as "tolerably satisfactory."

J. Boyd Davies: The Practical Naturalist's Guide, 80 pp, 12mo.—Takes up thoroughly all departments of the subject, with the exception of the stuffing of mammals and birds.

Robert Russell: North America, its Agriculture and Climate, containing observations on the agriculture and climate of Canada, the United States, and the Island of Cuba. 1 vol., 8vo, Edinburg and London; also, Little & Brown, Boston.

* Boston Advertiser.

HUGH MILLER: The Cruise of the 'Betsey,' or a Ramble among the Fossiliferous Deposits of the Hebrides: with Rambles of a Geologist, or Ten Thousand Miles over the Fossiliferous Deposits of Scotland. 8vo, 480 pp. Edinburgh, 1858.

JAHRESBERICHT, &c.: annual report on the progress of Chemistry, Physics, Mineralogy and Geology, for 1857. 2 vols. 8vo. Giessen, 1858.

FR. V. KOBELL: Die Mineralogie. Leichtfasslich dargestellt mit Rücksicht auf das Vorkommen der Mineralien, ihre technische Benützung, Ausbringen der Metalle, etc., 2d edit. 8vo, viii, and 248 pp. with 4 plates. Leipzig, 1858, Brandstetter.

CSP. KUHN: Die Käfer des südbayerischen Flachlandes, analytisch beschrieben, 16mo, viii, and 400 pp., with one lithographic plate. Augsburg, 1858, Kollmann.

F. LEBRUN: Description des échantillons recueillis à Essey la Côte. Basalte et ses minéraux. Tufs basaltiques. Roches métamorphiques et leurs minéraux, 8vo, 118 pp. with 5 plates. Nancy, 1858.

SGM. V. PRAUN: Abbildung und Beschreibung europaischer Schmetterlinge in systematischer Reihenfolge, 2–6, Heft. 38 pp. 4to, with 20 colored plates. Nürnberg, 1858, Bauer & Raspe.

PROC. ACAD. NAT. SCI., PHILAD. 1858.—p. 134, Locality of Argulus Catostomi; *Slack.*—p. 135, Note on Unio rubiginosus; *Lea.*—On *Salmo Gloverii*, Girard; *E. Harris.*—p. 137, Canker-worm (*Endalimia*) that attacks shade trees in Philadelphia, half destroyed by two species of Ichneumon; *Leidy.*—p. 138, Seven new species of Margaritana and four of Anodonta; *I. Lea.*—p. 139, Explanations of a second edition of a Geological Map of Nebraska and Kansas. &c.; *F. V. Hayden* (noticed in this volume, pp. 276, 404).—p. 159, Prodromus, &c., part vi, including the Crustacea Oxystomata of North Pacific Expedition; *W. Stimpson.*—p. 165, Descriptions of twelve new species of Uniones and other fresh water shells of the United States; *I. Lea.*—New species of fishes in the Museum of the Smithsonian Institution, collected in connection with the U. S. and Mexican Boundary Survey; *C. Girard.*—p. 171, Mineralogical Notes; *W. J. Taylor.*

PROC. BOST. SOC NAT. HIST. 1858.—p. 371, Habits of the Menobranchus; *S. Kneeland, Jr.*—p. 373, Spermatozoa of Hydra; *H. J. Clark.*—p. 374, Chemical analysis of the Scales of the Striped Bass; *J. Green.*—Rate of Growth of a Madrepore; *J. Wynan.*—p. 376, On the Egg-case of Skates; *J. Wyman.*—p. 379, Description of a new sparrow, Ammodronus Samuelis, from California; *Dr. Abbot*—p. 380, A form of monstrosity in a pig; *J. Wyman.*—p. 381, New Diatom, *Tryblionella elliptica*; *Stodder.*—p. 382, Biographical notice of J. Müller; *Agassiz.*—p. 383, On the Races of Algeria; *Bodichon.*

Prices of the prominent Paris Scientific Journals per year:

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Annales des Sciences Naturelles, including Zoology, Botany, etc. Monthly, 8vo, 88 fr.; the Botanical or Zoological part alone, 25 fr.
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Journal Asiatique, monthly, 8vo, 25 fr.
Journal de Conchyliologie, quarterly, 8vo, 13 fr.
Journal des Mathematiques, 4to, monthly, 30 fr.
Journal des Savants, 4to, monthly, 36 fr.
Nouvelles Annales de Mathematiques, 8vo, monthly, 12 fr.
Revue des Sociétés Savantes, 8vo, monthly, 20 fr.

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